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An Awakening in Non-Metallic Research

THE recently published partial report of Secretary Hoover's Advisory Committee for reorganization of the Bureau of Mines places unusual emphasis on the importance of technical study in the fields of the inorganic non-metallic minerals. No member of the committee represents any particular activity in the non-metallic field; the study was undertaken without undue weight of opinion in this direction. The recommendation that broad scope be given to this important field in Bureau of Mines activities provides considerable food for thought for mining engineers and research institutions.

A remarkably large share of the non-metallics enters the field of the construction industries, as readily appears when one calls to mind that the leading non-metallics are stone, sand, gravel, cement, lime, and gypsum. The structural industries, including not only the building trades proper, but also highway construction and public works, represent tremendous activities that are constantly being improved in engineering and technique. It is evident that research in the primary materials of construction should keep pace with progress made in their application, but such a condition is far from reaching an actuality.

The most outstanding as well as one of the youngest of the non-metallic industries is portland cement, which has grown from nothing to an industry of $300,000,000 annual production in fifty years. With all due respect to the excellent work being accomplished through the Portland Cement Association and the Bureau of Standards, it is true, nevertheless, that the utilization of cement has far outstripped the basic study on properties and processes of manufacture; the fundamental research so far conducted on this complex material is scarcely a drop in the bucket when compared with the years of study devoted to iron and steel in hundreds of localities at home and abroad. Others of the non-metallics, notably the stone industries, are old in use, but new in the field of research. Slate has been used for roofing in Europe for many centuries, and in America for upward of a hundred years, but, strange as it may seem, it is not yet fully decided just what slate is; the American Society for Testing Materials is now struggling with a definition that will apply equally well to all commercial slates.

There are evidences all about us that the non-metallics are entering a new era, a period of technical progress, of basic research. Some of these evidences may be enumerated: The establishment of an Engineering Bureau of the National Crushed Stone Association; numerous research fellowships such as those of the National Lime Association and Gypsum Industries; cement studies by the Bureau of Standards and Lewis Institute; co-operation of the Marble Dealers Association with the Bureau of Standards in working out methods of preservation and treatment of marble; co-operation of the National Research Council with the Foundrymen's Association for a study of molding sands; the formation of a subcommittee on slate of the American Society for Testing Materials to formulate standards, tests, and a proper classification of slates; and the establishment of a Non-metallic Minerals Experiment Station of the Bureau of Mines to deal exclusively with problems arising in this broad field. With this array of activities and agencies together with many others not specifically mentioned, one may confidently expect an increasing knowledge of the fundamentals, a knowledge that must inevitably result in improved conditions in all branches of construction—and construction touches every community, every home, and practically every human activity.

New Uses for Metals

HOUSES of steel and iron, railroad cars constructed in part at least of aluminum alloys, and a marked widening of the field available to rolled zinc—all these spell new uses and increased demand for the respective metals. In some cases this widening of its field for a certain metal has been a natural, fortuitous development, in others it has been brought about by careful study and publicity.

Such a campaign to further the use of iron and steel for dwelling houses has been under way for some time in the pages of *Iron Age*. Steel today is practical building material for this purpose, it avers. A writer, Prentice Mitchell, predicts an eventual large increase in the use of these metals for domestic building. The movement is already past the experimental stage. Abroad, contracts for 1,000 steel-frame houses have been let by the London County Council, and it is reported that twice this number of all-steel houses are to be built by the Scottish National Housing Association this spring. It is noted that across the water economy is the motive in the trend toward all-steel construction, whereas on this side, where there is more prosperity, architects and builders are seeking a superior type of construction.

Uses for aluminum have increased faster than that metal could be supplied. In the past few years applications entirely new have been developed and old ones have been widened. For instance, aluminum bronze powder has long been useful as a pigment, but it is only within the last two years that the value of aluminum paint has been realized for protecting the metal sides of tanks to prevent the evaporation of oil and other volatile liquids stored in them. Also, as bus transportation has become more important, another old field has been widened for aluminum sheet and castings and for structural shapes of strong aluminum alloys. It is said that the actual tonnage of other metals thus far replaced in this particular field is probably not

indicative of the importance of the development. Aluminum and its alloys are also being used in the manufacture of railway passenger cars, though here, too, the extent to which it has thus far supplanted steel is small. This, indeed, is worthy of attention when one considers what great saving in power can be effected by decreasing the weight of rolling stock. Another development in the transportation field is the use of strong aluminum alloys in the manufacture of individual containers for less-than-carload shipments of freight and express, a venture which two or more manufacturers are reported to be considering. In one of these instances the container when removed from the flat car becomes the body of a truck of special design. The automobile industry is also taking increasing quantities of the metal for the hardware that it requires, and a large tonnage of one of the alloys is going into the manufacture of the radiator shell of one of the most widely sold motor cars.

Shingles made of aluminum are also under experiment. Several test roofs have been erected, and the product is on the market. Light alloys of the metal are being used in making chairs and other furniture—this on a commercial scale, though the tonnage of metal thus far called for is not a true measure of importance of the development, it is said. Increasing quantities of aluminum sheet are being taken for making file guides for office use, which are being marketed with much success. Other important uses are for making radio parts, airplane propellers, and collapsible tubes. I-beams, channels, and angles of strong aluminum alloys, having tensile properties similar to those of mild steel, are now available in the market.

As can readily be seen, some of the new uses for metals indicate no profit to the mining industry in general. If copper supplants shingles or slate for roofing, the copper producer gains. But if zinc supplants copper for this purpose, or aluminum zinc, one branch of mining gains at another's expense. In the instances cited above, aluminum replaces wood in furniture and in airplane propellers; it takes the place of cardboard in file guides, but in most cases at present it supplants copper and brass, and seems likely to make inroads in the market for iron and steel.

Much progress has been made in widening the field available to rolled zinc. Once, the largest buyers of this material were the manufacturers of wash-boards and mason-jar caps and the sheet-metal trade which used it for stove-boards and bathtub linings. Today the zinc companies are able to produce a rolled metal of high ductility capable of being used on the most difficult draws as readily as other non-ferrous metals, it is claimed. Thus rolled zinc competes with brass, copper, and aluminum. Many new uses have been developed for zinc—in automobiles, washing machines, roofing, and innumerable small stampings where non-corrosive or non-magnetic qualities in the metal used are required.

Marked success has attended the efforts to popularize the use of copper for such domestic articles as house screens, gutters, and leaders. Of the myriad very cheap homes erected in the last few years in the environs of New York, thousands are now provided with gutters, leaders, and screens of copper, no matter how flimsy the structure may be, though previously this was unusual even in more expensive houses. This is an excellent example of what may be done by advertising.

Liquid Oxygen Explosive Underground and in Open Pits

RESULTS of the most recent important investigation of liquid oxygen as an explosive were presented at the February meeting of the A.I.M.E. in a joint paper by F. W. O'Neil and Herman Van Fleet. This research is undoubtedly the most comprehensive conducted up to the present time, its scope being wider even than that of the work done by Messrs. Kuryla and Clevenger at Pachuca, which was described by them at the corresponding meeting of the Institute in 1923. Mr. O'Neil, who is chief engineer of the Ingersoll-Rand Co., and Mr. Van Fleet, the vice-president of the Air Reduction Co., summarize the results obtained from research and practical work conducted jointly by these two companies since early in 1922. The practical work referred to included that done underground in the Witherbee-Sherman iron mines, at Mineville, N. Y., where an underground oxygen plant was operated, and in several quarries and open-pit mines, in particular that of the Calcite Quarry Co. at Myerstown, Pa. Besides this, the practice with L.O.X. in the iron mines of Lorraine, where liquid-oxygen explosive has its widest application in Europe, was investigated. It is pointed out, in this connection, that, in Lorraine, L.O.X. replaces black powder or its equivalent. All this, together with laboratory research on the properties of L.O.X. absorbent materials and cartridges, as well as study of the history and physical theory of L.O.X. as an explosive, was done by the joint investigators in the course of their work.

The conclusions drawn from the results are rather against the use of L.O.X. underground, but decidedly in its favor for quarry work. Underground the investigators find that where ground is heavy and abrasive, and the drill holes in consequence are considerably tapered, L.O.X. costs more than dynamite. Where comparatively short holes are drilled, without much loss of gage, as in Lorraine, it may be commercially profitable, especially if the price of dynamite is high. The Lorraine practice, it may be said, is comparatively unusual in metal mining. As to safety, L.O.X. seems to present no danger of premature detonation, though there is the risk of accidental ignition causing violent, long-flame conflagration. Its use eliminates the danger from missed shots, and so far as noxious gases are concerned it is undoubtedly superior to dynamite. Where firing must be done simultaneously in a large number of adjacent stopes, it is more difficult to time with L.O.X. than with dynamite. Finally, more holes are lost with L.O.X.

For quarry and open-pit work, however, the investigators find L.O.X. admirably adapted. Here its cost is much less than that of dynamite. In the open pit there is no difficulty in handling the material and charging the holes. Less labor is needed in loading, because the cartridges are merely dropped without ramming. There are no lights to ignite the cartridges, and here, too, the danger from missed shots is obviated.

It is unfortunate for the experimenters that the underground work at Mineville gave such adverse results. This failure is attributed to the fact that there the ground is hard and abrasive, the consequent loss in gage of drill steel resulting in considerably tapered holes, which could not be filled to the equivalent volume of dynamite owing to the non-plastic nature of L.O.X. This condition also produced an air cushion between

the cartridge and the wall of the hole, which the experimenters think may have had decided effect. These experiments will hardly, therefore, decide the fate of liquid oxygen for all underground use. In areas where the price of explosives is high and the ground ordinarily hard, further tests of this sort may be attempted, with perhaps more encouraging results.

Germany and the Metal Markets

GERMANY is second only to the United States among the countries of the world as a potential consumer of copper, lead, and zinc. For five years before the war, and in 1925, Germany's consumption of copper was in the ratio of three to two compared with that of Great Britain, and American producers of course supplied most of the metal. Because she produces lead and zinc in some volume herself, Germany may not be quite so important a customer for American producers of these metals as Great Britain is. However, as the metal markets of Europe and the United States are closely enmeshed, the source of the metal is of little importance. Any serious reduction in the rate of world consumption has an influence on the price in all markets. Consequently, the depression in Germany that started soon after the middle of 1925 was an important factor in the decline of world metal prices, though there was a lag of a few months. The following figures indicate in a concrete way the results on German metal consumption of the period of industrial stagnation:

Net Metal Imports Into Germany

Metric Tons

	Monthly Average 1924	Monthly Average 1925	December, 1925	January, 1926
Copper	8,059	16,086	5,818	5,230
Lead	3,284	10,201	3,365	6,301
Zinc	3,123	6,925	824	1,490

It is reasonably certain that recovery of general prosperity in Germany should be accompanied by important increases in the volume of metal buying, which in turn ought to have a favorable effect on the metal markets. Accordingly, it is particularly interesting to study the views of Benjamin M. Anderson, Jr., economist for the Chase National Bank—and by no means a habitual and invariable optimist in his opinions—on the German situation.

He does not dodge the fact that at the moment business is depressed, that unemployment is prevalent, and that bankruptcies are numerous, but he finds distinct encouragement in the confidence of German bankers and industrialists that the acute financial crisis has been safely passed and that a renewal of prosperity must follow the recuperative period that now is being passed through. Mr. Anderson outlines lucidly the causes of the crisis of 1925, setting forth as the biggest factor "the extraordinary effectiveness of the taxation program inaugurated after the Dawes Plan was set up." More money was raised than needed. While industry was bleeding from excessive taxation, state and municipal authorities used the surplus funds at their command to outbid private enterprise for men and materials. This increased production costs, and handicapped manufacturers of goods for export. Industry, likewise, was heavily burdened by high interest rates on money, advances to customers usually commanding between 13 and 14 per cent until recently. These and other factors strangled industrial activity.

However, Mr. Anderson sums up the following achievements in Germany since the inauguration of the Dawes Plan:

"(1) Currency stabilization has been achieved. The Reichsbank is in a strong position. It has adequate reserves of gold and foreign exchange. It has a liquid portfolio. The German people and the outside world now trust the mark. (2) The budget has been balanced and a fiscal surplus has been created. (3) There has been a scrupulous and exact performance of all of Germany's obligations to make reparation payments to date. (4) The German railways under the new administration are on a financially sound basis and are making profits. (5) The standard of life and conditions of living among the German people have been very markedly improved. (6) Germany has a strong industrial revival. This culminated, to be sure, in the crisis of 1925, * * * but the crisis itself has corrected many of the abnormalities which produced it. (7) Germany has gone through the crisis in orderly, disciplined fashion, and has, apparently, in March, 1926, already reached the bottom of the depression which inevitably follows a crisis. In the worst of this depression, conditions are immeasurably better than they were in the pre-Dawes Plan period, while under the surface there are many restorative forces at work, which promise another, more soundly based, upward move."

How rapid the recovery in Germany will be, no one can say with assurance. It will take time, of course, but the fact that the movement is in the right direction should be ground for universal satisfaction. Purely from the standpoint of self-interest it is important to metal miners throughout the world.

Panama Gold

LONDON reports the discovery of gold in Panama. Gold is not new in Panama, for it has been mined in a mediocre way for more than three hundred years. The London announcement should read, "A New Gold Mine Flotation." This time it is the Panama Corporation which reports the discovery as a "New Rand." A syndicate has had representatives in Panama since 1924 and has obtained mining concessions covering more than 4,500 square miles, the entire province of Veraguas, and another area in southeastern Panama near the Colombian border. The promoters and vendors ask the public to subscribe £500,000 to meet obligations and carry on prospecting operation. The promoters receive £1,000,000 in shares. This announcement has not been kindly received by the investing public—three of the leading London financial papers taking exception to the way the issue was made. The prospectus is full of matter, but not of a satisfying nature. The mine has not been proven. Working costs and mining conditions are not detailed. The public is asked to put up all the money, take all the risk, and while the syndicate promoters have disposed of the concessions to the corporation with outlay returned, they are still to receive two-thirds of whatever is found by the public's financing. The underwriters also get an option to subscribe at par for £250,000 in shares of the corporation up to Dec. 31, 1927. This gives ample time for the public's money to prove the ground. The underwriters, therefore, can take up the option if it is promising or let it alone, and the public takes the loss. London advices state that if the financing of the undertaking had been on a moderate scale some of the shortcomings might have been overlooked.

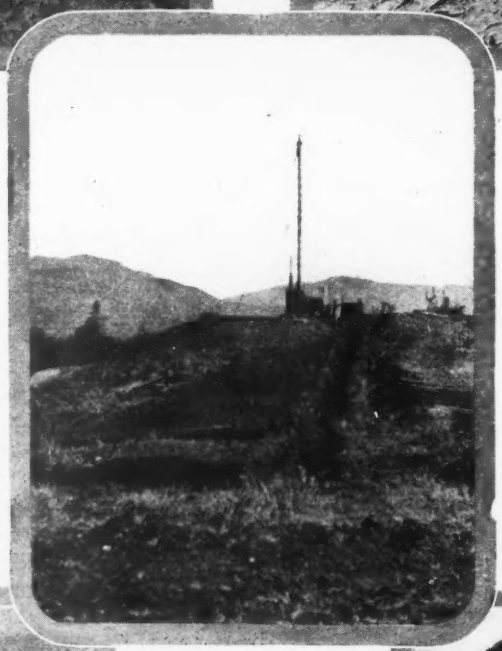
Whether there is gold in Panama or not is not the question. The public should know the facts before being asked to put up its money.

In the Lydenburg Platinum District, in the Transvaal

Above—Main workings on Farm Onverwacht. The pile in the foreground is platinum ore from development work. The deposit here is a pipe-like body of hortonolite-dunite, said to have a platinoid content of 24 dwt. per short ton down to the 100-ft. level, though somewhat lower in grade below.

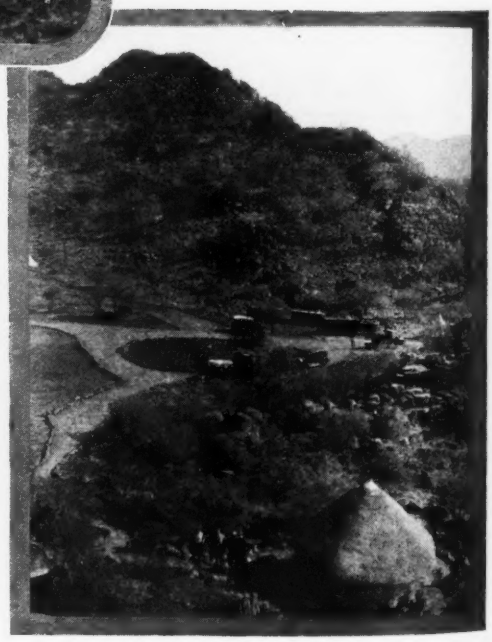
Above—Collar of No. 2 shaft on Farm Onverwacht.

Left—Prospecting a hortonolite-dunite orebody with a churn drill on Farm Mooihoek. The Onverwacht and Mooihoek orebodies, with a third on Farm Driekop, lie on a line about 8 miles long.



Left — Entrance to one of the inclines on the main ore horizon, on Farm Forest Hill. "Chrome reefs" carrying platinoid metals have been traced for 6,000 ft. or more here.

Right — Camp of Northern Platinum Exploration, Ltd., near Oliphants River.



Platinum in the Transvaal and Elsewhere—I

By A. W. Newberry and James F. Kemp

General Geological Relations of Platinum

By James F. Kemp
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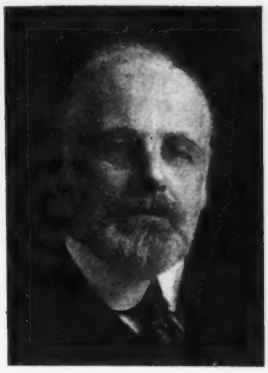

Prof. J. F. Kemp

As introductory to Mr. Newberry's contribution on the recent developments in the Transvaal, the following brief summary of previous experience with platinum and its allied metals may serve to establish a comprehensive point of view. Platinum is the most important of the six metals which constitute the "Platinum group" — namely, three with high atomic weight, platinum 194.9, iridium 193.1, and osmium 191; and, by contrast, three with much lower ones, palladium 107, rhodium 103, and ruthenium 101.7. Gold (197.2) is sometimes associated by chemists with the first three, and, indeed, the whole seven metals are described as the "gold group." Platinum and gold have slight, if any, tendency to oxidize. Palladium, rhodium, and iridium oxidize when heated to moderate temperatures in oxygen, but part with the oxygen on strong ignition. Ruthenium and osmium form volatile stable oxides.

Osmium is the most refractory, and at temperatures ordinarily available in our laboratories cannot be melted. Ruthenium, iridium, and rhodium follow in order of decreasing but still very difficult fusibility. Platinum is next, and melts at the very high temperature of 1,779 deg. C. Palladium has the lowest fusing point of all six, and is usually described as melting at about the same temperature as wrought iron. Its high fusibility, its resistance to the ordinary chemical reagents, and its properties as a catalyzer and absorbent of gases give platinum extraordinary scientific and industrial value. Its recent extensive use in jewelry, in response to the demands of fashion, is deplorable from every utilitarian and scientific point of view.

Platinum has proved hitherto to be limited in distribution. Far the largest part of the world's supply has been obtained in the metallic state, as nuggets and grains in placer deposits derived from the very basic rocks, peridotite and pyroxenite, which are commonly serpentinized. The nuggets and grains are never pure platinum, but must be refined by processes requiring high technical skill. In a compilation in 1902 (Ref. 1, pp. 18-20)[1] of forty-four complete analyses of nuggets, I found the richest in platinum to be 86.50 per cent, and the poorest, 19.64. Except in the six cases at the low end of the list, containing platinum 66.30-19.64, the most abundant other element in the nuggets was metallic iron, which ranged in the thirty-eight cases from a maximum 18.93 per cent (Pt 68.95) to a minimum 4.45 (Pt 79.83). In almost all cases the four other metals of the platinum group—iridium, rhodium, palladium, and osmium—were found in a combined total of several per cents; and, in addition, scales of iridosmine (or osmiridium) were mechanically included in the nuggets. In no instance was the remaining metal of the group, ruthenium, detected. The specific gravity of the nuggets varies from 14 to 19. Purified and melted platinum is 19.7, but hammering may raise it to 21.23. Inclusions of iridosmine, specific gravity 19.3 to 21.13, raise the specific gravity of the nuggets; iron lowers it. In the minimum case of platinum, 19.64 per cent, iridium was determined at 76.80. In four other low platinum instances, iridosmine varied from 22.55 to 37.30.

Attached to the nuggets and intergrown with the metallic part, one sometimes finds chromite. Still more rarely, adhering olivine and pyroxene may be observed. As a great but interesting rarity, visible gold may form a part of a nugget; but only after sorting over many ounces of crude platinum did I find one or two such cases, both from Colombia, in an investigation made twenty-five years ago. (Ref. 1, Pl. II, A and B.)

Aside from the nuggets in which platinum predominates, iridosmine is also obtained in commercial quantities by itself in scales and in rude, small, platy crystals. Grains of palladium are excessively rare, and all the commercial supply of the metal is obtained in association with platinum. The other members of the group are still rarer.

Other Sources Besides Placers

In addition to the supplies of the platinum group of metals from the placer mines, contributions to the markets are obtained from certain forms of ores or ore deposits. The copper-nickel sulphides in rocks of the gabbro family contain amounts which may be commercially saved from the residues deposited in electrolytic refining. As the copper passes to the kathode, the platinum group drops with the insolubles left in the sludge. Sudbury, Ontario, is the outstanding illustration of these ores, and from the refineries a modest contribution is sent each year into commerce. So far as we know, palladium is customarily associated with the platinum in orebodies of this type. We have also much reason for the inference that the platinum comes in large part from sperrylite, $PtAs_2$, the only known natural compound of platinum other than an alloy. Sperrylite favors the chalcopyrite as a host rather than the pentlandite and pyrrhotite. The quantity of sperrylite is so minute, however, that one must speak with caution, since it is not often visible to the eye in the crude ore. (Ref. 2.)

[1]References will be found at the end of this article.

Sperrylite has been detected in several other localities by dissolving copper ores and obtaining it in the residues. (See Ref. 2). A careful review of the reported geological associations of platinum reveals many instances of other mother rocks than the peridotites and dunites and some other associations than the copper-nickel ores of the Sudbury type, although these have been the most productive up to the present.

In Granite in Tulameen River Region

After four months' field work in 1901 in the Tulameen River region of southern British Columbia, where most of the placer platinum has come from peridotites and pyroxenites indistinguishable from those of the Urals, A. W. Johnston and myself were able to demonstrate the presence of platinum up to one-eighth of an ounce per ton, by assay, in a sheared and chloritized zone in granite. (Ref. 1, p. 50). Shales or slates from Arizona and Pennsylvania have been reported to yield the metal by assay. (Ref. 1, pp. 51 and 59). J. W. Finch has shown in a report in 1925 that it appears in a narrow dike of peridotite or some related rock. The dike traverses steeply dipping limestone in the Medicine Bow Range of Wyoming, only a few miles from the New Rambler mine. The dike is at times schistose from pressure and shearing. Of seven samples along 100 ft. of tunnel in solid rock, two yielded from a quarter to a third of an ounce of platinum and palladium. (Ref. 3). Platinum was reported in wollastonite from a contact zone of lime-silicates, at a crossing of the Singenggoe River, near the village of Moeara Sipongi, Sumatra, 35 miles from the sea, by L. Hundeshagen, in 1904. The intrusive was granite. (Ref. 4).

In Brazil, as described by E. Hussak, there are two localities in the State of Minas Geraes, Candonga and the Gongo Seco mine, where palladium-gold ores have been extensively mined from zones of lime-silicates produced by contact metamorphism, the intrusive being granite with associated pegmatities. (Ref. 4a). The platinum group may thus sometimes be furnished to contact zones by acidic intrusives.

E. Gueymard, in 1849, announced the presence of platinum in tetrahedrite from metamorphic limestones, on a mountain called Chapeau, above Chatelard, in the Department of Hautes Alpes, southeastern France, and, in 1854, in bournonite in similar geological surroundings in the Department of Isere. (Ref. 5).

Platinum in Limestone in the Boss Mine

The most interesting addition to our knowledge regarding platinum in limestone has resulted from the discoveries at the Boss mine, Yellow Pine district, southwestern Nevada. The discovery of the platinum was made by F. A. Hale, Jr., in 1914, and announced by D. T. Day in "Mineral Resources" for 1913, U. S. Geological Survey, published in 1914. (Ref. 6). The best account of the platinum is by Adolf Knopf. (Ref. 6). The mineralization consists of siliceous copper-gold ores along a nearly vertical crushed zone in dolomitic limestone of late Mississippian age. Through the mineralized lode run narrow veins, an inch and less wide, containing bismuth-bearing plumbo-jarosite, a hydrated sulphate of iron and lead. This rare mineral is sometimes a yellow powder and sometimes a green talc-like mass, and is associated with sandy or solid masses of minute, well-crystallized quartz grains containing also octahedrite. The plumbo-jarosite gave extraordinarily high values in platinum and palladium as well as gold. The precious metals are in the native state, but are black until scrubbed and cleaned. The intrusives of the district are dikes of quartz-monzonite and granite porphyry. The plumbo-jarosite is obviously an oxidation product in the belt of weathering.

Much interest was felt in 1913 over the announcement of the discovery of platinum in graywackes of the Silurian and Devonian systems, in the Lower Rhine region, Germany, but whatever production may have resulted has had little effect on market conditions. (Ref. 7).

Fine Platinum in New South Wales

In the extreme western part of New South Wales, in 1889, a gossany iron cap, which passed in depth into a decomposed band of gneiss or schist, was reported by J. M. Jaquet to contain platinum from a quarter ounce to one and a half ounces per ton, but not to go below the capping. It seemed to be on the outcrop of a fahlband. The platinum was too fine to be visible, but was revealed by assays. (Ref. 8).

The French traveler, Boussingault, described as early as 1826 platinum from the Province of Antioquia, Colombia, in such relations that it seemed to come from an auriferous quartz vein in syenite or syenitic gneiss, which, with porphyritic greenstones, is believed to extend from Santa Rosa over into the Choco district, where active dredging has been in progress in recent years. The Choco nuggets have in instances attached chromite, however, and this mineral argues the derivation of much, if not all, of the platinum from the usual basic magnesian rocks. (Ref. 9).

A Wide Range of Geological Associations

From the above condensed review, which could be expanded were it desirable, the conclusion is apparent that the platinum group have a wide range of geological associations. To the ones already familiar, the South African belt adds another in contrast to them.

Only passing mention has been made of the normal association of platinum with the basic magnesian peridotites and pyroxenites. That far the greater part of the platinum of the world has been washed from placers produced by their erosion in the Urals, is a matter of elementary geological knowledge. Were more details desired, the citations under Ref. 1 and Ref. 10 may be consulted. The richest platinum placers in North America have been found along the Tulameen River, in southern British Columbia, and these are briefly described in Ref. 1, and more at length in Ref. 11. While the Urals are an old land area and worn down to moderate relief, the Tulameen district is a young land area and characterized by deep, narrow, and steep-sided valleys. Far less relative concentration has taken place from basic magnesian rocks which may have been no less rich originally than those in the Urals.

The same geological relations prevail in southwestern Oregon, where, in the vicinity of Kerby and Waldo, the gold placers have yielded the richest amounts of platinum of any locality in the United States, but the output is not a very serious contribution to the world's supply. In recent years, since the almost complete cessation of production in the Urals, the Choco district of southwestern Colombia has assumed leading importance. Dredging is practiced, but the area is fever-ridden for cold-climate people, and suffers from this, the usual dis-

advantage of tropical valleys of no great elevation above the sea.

It has been impossible to mention all the localities of platinum in a brief article, and descriptions of others will be found in general papers by J. M. Hill and W. L. Uglow. (Ref. 12.)

References

(1) "Geological Relations and Distribution of Platinum and Associated Metals." U. S. Geol. Surv., Bull. 193; 91 pp., 1902.

(2) Sperrylite was first detected in 1888 by F. L. Sperry in the mortars of a stamp mill treating gold quartz and gossan gravel, at the Vermillion mine, west of Sudbury, Ont. It was analyzed, described, and named by Professors Wells and Penfield. *Amer. Jour. Sci.*, Vol. 37, 3 ser.; 67-70, 71-73, 1889. See also T. L. Walker, idem. Jan., 1889, p. 67, and also Vol. 1, 4 ser. 110-112, 1896; C. W. Dickson, Vol. 15, 4 ser. 137-139, 1903. W. E. Hidden subsequently announced it from Macon County, N. C. *Amer. Jour. Sci.*, Vol. 6, 4 ser. 381-383, 1898. Platinum at the New Rambler mine, 40 miles west of Laramie, Wyo., was reported by W. C. Knight in the *Engineering and Mining Journal*, Vol. 72; 845, Dec. 28, 1901; and Wells and Penfield soon after identified sperrylite in the ore, which is covellite, *Amer. Jour. Sci.*, Vol. 13, 4 ser.; 95-96, Feb., 1902. The local geology was subsequently described by J. F. Kemp, U. S. Geol. Surv., "Mineral Resources" for 1902: 244-250, published 1904. As the assays of matte bottoms indicated high percentage of palladium with the platinum, T. T. Read, working with myself, dissolved two or three pounds of the covellite in cyanide solution, hoping to separate the unknown palladium mineral, but while we obtained a few crystals of sperrylite, the palladium mineral eluded identification. T. T. Read, "Platinum and Palladium in Certain Copper Ores." *Engineering and Mining Journal*, Vol. 79; 985-986, 1905. Jules Catherinet, working under me, detected sperrylite in massive bornite from a pegmatite dike near Copper Mountain, in British Columbia. *Engineering and Mining Journal*, Vol. 79; 125-127, 1905.

(3) J. W. Finch. "Platinum Discoveries in Wyoming." *Engineering and Mining Journal-Press*, Vol. 120; 95-96, July 18, 1925.

(4) L. Hundeshagen: "The Occurrence of Platinum in Wollastonite on the Island of Sumatra, Netherlands East Indies." *Trans.*, Inst. of Mining and Metallurgy, London, Vol. 13; 550-552, 1905.

(4a) E. Hussak: "Ueber das Verkommen von Palladium und Platin in Brasilien." Zeitschr. für prak. Geologie, 1906; 248-293. The original and more detailed paper is in the Sitzungsber. der K.K. Akademie der Wissenschaften, Vienna, 113; 394-425, 1904.

(5) E. Gueymard: "Memoirs historique sur la decouverte du platine dans les Alpes." Comptes Rendus 29; 814, 1849; 38; 941, 1854.

(6) Fred. A. Hale, Jr.: "Platinum Ore in Southern Nevada." *Engineering and Mining Journal*, Vol. 98; 641-642, October, 1914. Also, *Trans.* A.I.M.E., Vol. 59; 93-111, 1918. J. M. Hill: "The Yellow Pine Mining District, Clark County, Nevada." U. S. Geol. Surv., Bull. 540; 228-240, 1914. Adolf Knopf: "A Gold-Platinum-Palladium Lode in Southern Nevada." U. S. Geol. Surv., Bull. 620; 1-18, 1915. S. W. Mudd: "The Boss Mine, Good Springs, Nev." *Mining and Scientific Press*, Vol. 110; 297-298, Feb. 20, 1915.

(7) Translation by F. Sommer Schmidt of a report by Paul Krusch in *Metall und Erz. Mining and Scientific Press*, Vol. 109; 879-881, Dec. 5, 1914.

(8) J. B. Jaquet: "Report of the Department of Mines and Agriculture, New South Wales, for 1892, p. 143, and of the Geological Survey, New South Wales, 5; 33, 1896.

(9) Boussingault: Annales Chem. et Phys., 32; 204, 1826. Pogg. Annalen, 7; 515, 1826; 10; 490, 1827.

(10) From Prof. Louis Duparc, of the University of Geneva, Switzerland, sometimes aided by his junior officers, a long series of papers and monographs have appeared in recent years, too numerous to cite here. They culminate in "Le platine et les gîtes platinifères de l'Oural et du Monde." Geneva, 1920. C. W. Purington: "The Platinum Deposits of the Tura River System, Ural Mountains, Russia." *Trans.* A.I.M.E., Vol. 29; 3-16, Feb., 1899.

(11) Charles Camsell: "Geology and Mineral Deposits of the Tulameen District, British Columbia." Memoir 26, Geol. Surv. Canada, 1913.

(12) J. M. Hill: "The Platinum Situation." *Engineering and Mining Journal*, Vol. 108; 131-137, July 26, 1919. W. L. Uglow: "Geology of Platinum Deposits." *Engineering and Mining Journal*, Vol. 108; 352-355, 390-393, Aug.-Sept., 1919.

Recent Platinum Developments in the Transvaal

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TRACES OF PLATINUM have been reported from time to time within the last ten years in the ultrabasic rocks of the Bushveld igneous complex, but it was not until July, or perhaps August, 1923, that Dolph Erasmus made what may be regarded as the first important discovery of the metal. T. A. Rickard, in *Engineering and Mining Journal-Press*, Vol. 120, p. 334, tells the story of the Waterberg find as well as that of the discovery of platinum on farm Maandagshoek No. 148 made about a year later.

On my first visit to Johannesburg, in March, 1924, I was told of the Waterberg discovery and of the formation of the pioneer platinum company of the region, Transvaal Platinum, Ltd. My informant spoke of the flotation of other companies to exploit adjoining ground, but stated that the orebodies of the pioneer organization had so far proved to be rather limited in horizontal extent and that neighboring areas had yielded nothing of importance. The same was true of this district twenty months later as I was leaving Johannesburg for home after a rather detailed investigation of platinum occurrences in the Transvaal covering a period of four months. The orebodies of Transvaal Platinum, Ltd., had been found to persist to the greatest depth obtained, 150 ft., but no important lateral extensions had been brought to light.

In the Lydenburg district, on the other hand, discovery followed upon the heels of discovery with such bewildering rapidity, and so many companies were formed to exploit not only potentially platiniferous areas but also eager and unsuspecting buyers of stock certificates, that a boom of no mean proportions ensued. This boom reached its height on the Johannesburg Stock Exchange early in March, 1925, and has subsided gradually since that time. An important new district, extending 15 miles south and 30 miles north from Potgietersrust, has been found to possess valuable orebodies, but the discovery of platinum in this part of the Transvaal was kept very secret until most of the area had been taken under option.

There were no signs of a boom in the platinum districts themselves. So great is the extent of the area in which the discoveries have been made that relatively little activity is to be found at any one place. Lydenburg, one of the earliest Boer settlements north of the Vaal, remains a quiet country town, with wide streets shaded by large and beautiful trees. About the only sign of platinum activity is the presence of several new

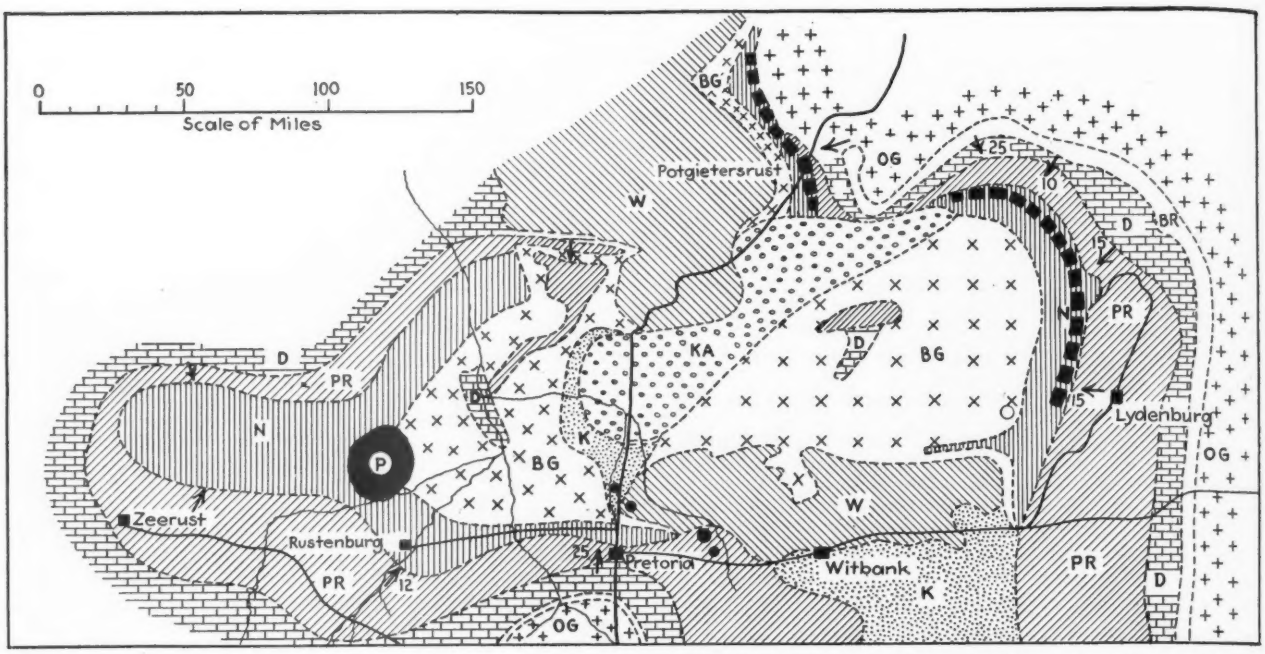


Fig. 1—Geological sketch map of the central Transvaal, showing position of the platinum deposits in the Lydenburg district. This is indicated by the line of black squares at right

OG—Old granite; *BR*—Black Reef; *D*—Dolomite; *PR*—Pretoria series; *W*—Waterberg system; *N*—Norite; *BG*—Bushveld granite; solid black circles—Nepheline rocks; *P*—Pilansberg complex; *K*—Karroo system; *KA*—Bushveld amygdaloid.

garages well filled with American touring cars, which offer the only practicable means of transport to the platinum fields. Potgietersrust is comparable to Lydenburg now, but is likely to show much greater activity before the middle of 1926, as it is practically the only railroad point for the Potgietersrust district. Most of the machinery and supplies for the central and northern parts of the Lydenburg district will be unloaded at Fort Burger, some 40 miles north by west of Lydenburg, and the extreme north end of the district will doubtless be supplied from Pietersburg, the principal distributing point in the central part of the Transvaal.

Rocks of the Transvaal **Stratigraphic Column**

North American Equivalent	System	Series	Member
Jurassic.....	.....	Stromberg	Bushveld amygdaloid Bushveld sandstone
Triassic.....	Karroo.....	* * *	.....
Permo-Carboniferous	.....	Ecca.....	Sandstones, shales, coals and Dwyka conglomerate
		* * *	
Devonian.....	Waterberg....	Waterberg	Sandstone and quartzite, 5,000 ft. Shale and sandstone, 2,000 ft. Felsitic lavas and tuffs, up to 8,000 ft.
		* * *	
		Pretoria 10,000 ft.	Quartzite, slate, basic intrusives
(?)	Transvaal	Dolomite 7,000 ft.	Dolomite, chert, shale, intrusive syenite
		Black Reef 200 ft....	Quartzite, shale, conglomerate
		* * *	
(?)	Ventersdorp...	.....	Klipriversberg amygdaloid, Boulder beds, volcanic breccias Elsburg series
		* * *	
		Upper.....	Kimberley Bird Main Reef
(?)	Witwatersrand		Doornfontein slate Hospital Hill quartzite Hospital Hill slate
		Lower.....	Speckled bed Red slate Ripple marked bed Water Tower slate Orange Grove quartzite
		* * *	
Archaean.....	Swaziland.....	.....	Schist, slate, quartzite, conglomerate, intrusive granite

Note—The Bushveld igneous complex is intermediate in age between the Pretoria and Waterberg series. It may overlap the Waterberg to some extent.
* * * indicates an unconformity.

Since practically the whole of the world's platinum production to date has come from placers, mining men, almost without exception, were slow to acknowledge the importance of these lode discoveries. Then, when their true significance began to be felt, many swung too far the other way. Even in the absence of conclusive metallurgical results one could hear such predictions as "Even though the price of platinum should fall to that of gold, this or that property will show enormous profits."

The Lydenburg District

Hold up your right hand, crook your forefinger at 60 deg. and you have the outcrop of the more basic portion of the Bushveld igneous complex in the Lydenburg district, on a scale of 20 miles to the inch. The first phalanx represents the north-south section of the norite belt from farm Sterkfontein No. 175 northward to the Steelpoort River; the second represents that section lying between the Steelpoort and farm Twickenham No. 336; and the third phalanx, or finger tip, the section between Twickenham and the Olifants River. It is not practical to show on the accompanying map, Fig. 2, the exact boundaries of the various holdings, but I have indicated by initials the parts of the area now being developed by the principal platinum companies.

Broadly considered, the region is one of rugged topography. Scarps abound and elevations range from about 2,300 ft. in the valley of the Olifants to more than 7,500 ft. in the extreme southern part of the area. The most precipitous scarps are those of the northeast face of the Lulu Mountains a little north of the center of the district; but there are also broad valleys, one in particular averaging perhaps four miles in width and extending practically without interruption from farm Dwarsrivier No. 86 to the Olifants, a distance of 55 miles. Once the railway line has been carried across the Steelpoort into farm Winterveld No. 424, the linking up of the various properties will present no particular difficulty except in the extreme southern part.

Small thorny trees are plentiful on the mountain slopes and sparsely distributed through the valleys. They will afford firewood for a limited time, but the timber would be of no value for supporting excavations. There is an abundance of water over most of the area, but it will probably never be feasible to develop hydro-electric power within the district. A great possible source of power is the Olifants River below its confluence with the Steelpoort at an air-line distance of 30 to 50 miles from the center of the district. Coal has satisfied all the power requirements of the Witwatersrand for many years, and it is reasonable to suppose that the platinum regions of the Transvaal will find this source of power cheapest and best. The Witbank collieries are only 100 miles air-line distance, or 220 miles by existing railway route, from the center of the field.

Dr. P. A. Wagner on Lydenburg Geology

The general geology of the Lydenburg district is so concisely set forth by Dr. Wagner[1] that I shall quote the following verbatim:

"The platinum occurs as a primary constituent of certain ultrabasic and basic rocks of the norite zone of the Bushveld igneous complex. This complex is an extensive irregular oval-shaped body of igneous rocks occupying the greater part of the central Transvaal, and extending from the western boundary of the province to the central part of the Lydenburg district. It is composed in its outer or lower portion of norite and ultrabasic rocks, and in its inner or upper portion of granophyre and red granite. . . . The granite is somewhat later than the norite and intrusive in it.

"The norite zone is a vast basin-shaped sheet or lopolith some three miles in thickness. It was intruded in pre-Waterberg times into the uppermost part of the Pretoria series. . . . In some areas the sheet is fairly uniform throughout. In others its lower portion has been marvelously differentiated. . . .

"Another feature of the norite zone is that the rocks composing it are, as a rule, pseudostratified to a remarkable degree, behaving exactly like well-bedded sedimentaries. The pseudostratification is parallel to the bounding surface of the sheet, and thus conforms in a general way with the strike and dip of the Pretoria beds. . . .

"The area under review is one in which the lower one-fourth of the norite sheet exhibits great heterogeneity, being made up of a considerable variety of rocks which, in conformity with the disposition of the Pretoria series, have a prevalent north-south strike and dip to the west at from 9.3 deg. to 14 deg, the pseudostratification being throughout of the utmost regularity. The rocks composing this lower part of the sheet comprise bronzitite, chromite-bronzitite, harzburgite, dunite, serpentine, silicified serpentine, anorthositic norite, chromitite or chromite rock, and magnetite rock, to mention only the more important varieties.

"The chromitites in particular have attracted a good deal of attention of late, and an attempt is being made at the present time to work them on a big scale. In the central part of the platinum belt the chromite rock, which forms lenses and bands up to 6 ft. in thickness, appears to follow two fairly definite horizons, the lower or main horizon lying from 75 to 400 ft. below the upper. Small lenses of chromite rock occur between these two horizons and outside the limits given. It should also be stated that the chromite zone does not everywhere occupy the same position relative to the base of the norite sheet, there being fairly considerable variations in this respect."

The upper three-fourths of the norite zone, in contradistinction to the lower one-fourth, is of a very uniform character, being occupied mainly[2] by mottled gray norites, except in its uppermost portion, where there are great stratiform segregations of titaniferous magnetite associated with bands of anorthosite[3].

Diabase dikes with a prevalent northeast-southwest trend intersect the rocks of the norite zone at many localities. On Driekop No. 170 a big body of tourmaline-bearing pegmatite cuts across the platiniferous norite.

Primary Ore Deposits of Three Classes

Three classes of primary ore deposits have been recognized to date. They are:

1. Pipe-like bodies and irregularly shaped masses of hortonolite dunite[4].
2. Tabular bodies conforming to the pseudo-bedding, with chromite as a principal gangue mineral.
3. Tabular bodies conforming to the pseudo-bedding in which chromite occurs only as a very minor constituent of the mass.

Only three ore occurrences are of record under Class 1. Two of them, one on farm Onverwacht No. 330 and the other on farm Mooihoek No. 147, were among the first discoveries made. The third, on farm Driekop No. 170, was found a few weeks later. These three platiniferous orebodies lie approximately on a line 8 miles long and outcrop between the two chromite horizons mentioned by Wagner. For several months it was thought that these occurrences constituted a distinct platinum horizon, and this may still be the case, although practically all the dunite pipes in the vicinity—and there are dozens of them—have been prospected without exposing another orebody. For the present then we are forced to consider the three exposures as isolated occurrences, along a line of weakness perhaps, but not constituting an ore horizon.

The Onverwacht pipe deserves special mention. It is practically vertical to the greatest depth so far attained, about 300 ft. Sixty feet in diameter at the outcrop, it had contracted at the 100-ft. level to an oval cross-section, 36 by 51 ft. The average platinoid content down to the 100-ft. level is said to be 24 dwt. to the ton of 2,000 lb. At the 100-ft. level it is a little over 20 dwt. The pipe appears to maintain its size below that point, but the platinoid content at the 150-ft. level was found to be 9 dwt. and at the 200-ft. level 4 dwt. Below the 200-ft. level better values are reported.

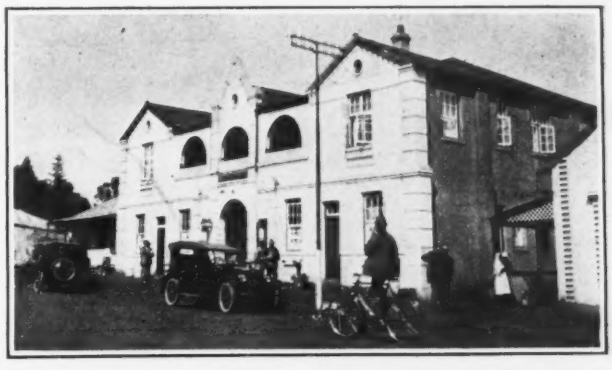
The other two occurrences of this first class are con-

[1] Percy A. Wagner: Industries Bulletin Series (South Africa) No. 102: "The Platinum Deposits in the Western Part of the Lydenburg District, Transvaal."

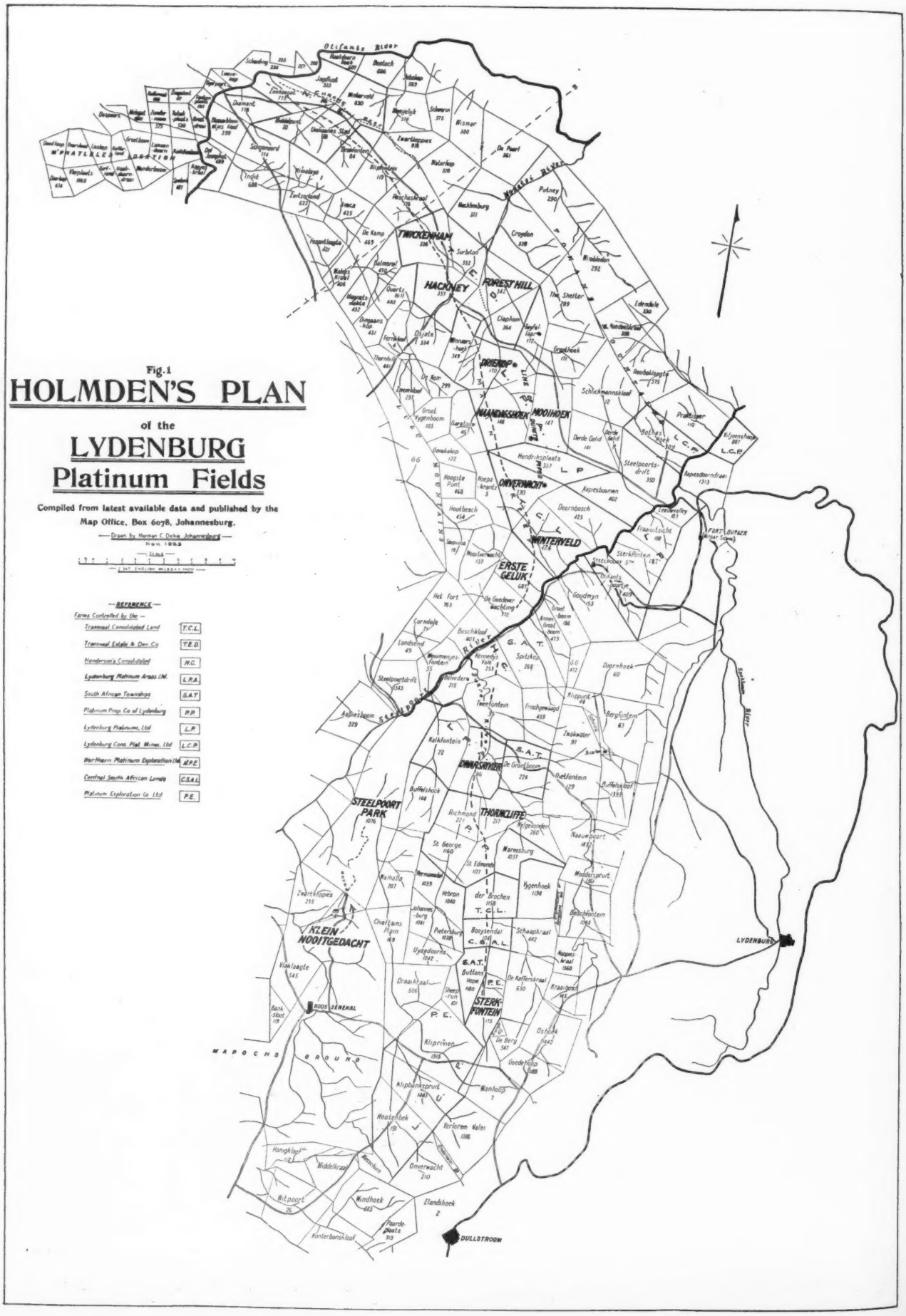
[2] Cf. Hall, A. L.: Explanation to Sheet 8 (Sekukuniland), pp. 30-35 and Explanation to Sheet 11 (Lydenburg) pp. 30-32.

[3] Cf. Hall, A. L.: Rep. Geol. Survey Transvaal, 1909, pp. 70-72.

[4] Hortonolite is olivine in which the molecular ratio of FeO to MgO is approximately as one to one. The name was proposed by P. A. Wagner and E. T. Mellor. See "On Platinum-bearing Hortonolite Dunite of the Lydenburg District." *Trans.* Geol. Soc. South Africa, 1925, p. 76.



Grand Hotel, Lydenburg. The starting point for expeditions into the Lydenburg district


Olifants River
Steelpoort River
Spekboom River
TWICKENHAM
HACKNEY
FOREST HILL
DRIEKOP
WAANDERSHOEK
MOOIHOEK
ONVERWACHT
WINTERVELD
ERSTE GELUK
STEELPOORT PARK
THORNCLIFFE
KLEIN NOOITGEDACHT
STERKFONTEIN
LYDENBURG
DULLSTROOM
MAPOCHS GROUND
ROOS GENERAL
Fig.1
HOLMDEN'S PLAN
of the
LYDENBURG
Platinum Fields
Compiled from latest available data and published by the Map Office, Box 6078, Johannesburg.
Drawn by Norman C. Dicke, Johannesburg
Nov. 1943
— REFERENCE —
Farms Controlled by the —
Transvaal Consolidated Land T.C.L.
Transvaal Estate & Dev. Co T.E.D.
Henderson's Consolidated H.C.
Lydenburg Platinum Areas Ltd. L.P.A.
South African Townships S.A.T.
Platinum Prop. Co. of Lydenburg P.P.
Lydenburg Platinums, Ltd L.P.
Lydenburg Cons. Plat. Mines, Ltd L.C.P.
Northern Platinum Exploration Ltd N.P.E.
Central South African Lands C.S.A.L.
Platinum Exploration Co. Ltd P.E.

siderably larger than the one on Onverwacht and of correspondingly lower grade. Not enough development has been done on them to determine whether the ore occurrences are pipe-like or irregular in form. The Mooihoek showing has been proved by core drilling to a vertical depth of 300 ft.

The hortonolite dunite which constitutes these three ore occurrences is thus described by Wagner:

"It is a dark, heavy rock weathering with a characteristic rustlike crust of brown or blackish-brown color. On freshly fractured surfaces the color ranges from deep honey-brown to greenish-brown. In hand specimens it appears to be very coarse-grained. Actually the grain is very uneven, and while one frequently sees hortonolite individuals up to 2 cm. and even 3 cm. long, the average grain measured in the thin sections is only about 1.5 mm. It has the distinction of being the heaviest igneous rock composed essentially of silicates hitherto described from any part of the world, the specific gravity being 3.752. In some of the chromite-rich varieties the specific gravity is 3.9. It is composed predominently of interlocking anhedra of deep honey-brown hortonolite with pronounced greasy luster. . . . The mineralogical composition of a typical fresh-looking piece from Onverwacht No. 330 was found by the Rosiwal method to be as follows:

	Per Cent		Per Cent
Hortonolite	93.2	Chromite	0.25
Diopside	5.0	Magnetite	0.05
Hornblende	1.5		

"The chemical analysis of the same specimen, which contained 33.8 dwt. of platinum to the short ton, gave the following result:

	Per Cent		Per Cent
SiO_2	34.25	MgO	22.00
TiO_2	0.05	CaO	2.35
Al_2O_3	1.45	K_2O	Nil
Cr_2O_3	0.10	Na_2O	0.20
Fe_2O_3	2.90	P_2O_5	0.05
FeO	35.50	CO_2	Trace
MnO	.40	H_2O	0.55
NiO	Trace	Total	99.85

"One of the most remarkable features of the rock, as compared with other olivine rocks of the Bushveld complex, is its freshness, this being the more remarkable when, as on Mooihoek, it occurs in direct contact with serpentine evidently derived from the normal dunite composed of magnesia-rich olivine. . . . The rustlike crust above referred to is never more than a millimeter or two in thickness, and immediately beneath it apparently unaltered hortonolite with characteristic greasy luster is always in evidence. . . . The rock outcrops prominently. It is, as a rule, well jointed, and weathers in big rectangular blocks and slabs. These in the course of time become rounded at the edges and ultimately break up into smaller fragments that travel for considerable distances down the slopes of the hill on which it outcrops. Isolated pebbles of the rock are also found in the alluvial deposits. . . .

"Platinum is present in the dunite in well-shaped crystals, crystal aggregates, irregular rough grains, small nuggets, and spike-shaped forms, often curved, in which the blunt end shows the faces of the cube."

No examples of Class 2 had been found up to the time Dr. Wagner's report was published. The first discovery of platinum ore associated with chromite was made in the northern part of the district early in 1925. Since that time "chrome reefs" carrying appreciable quantities of platinoid metals have been traced for a distance of almost ten miles southeastward from the Olifants River and for a distance of 6,000 ft. or more on farm Forest Hill No. 342, lying about midway between the Olifants and the Steelpoort. The two reefs are similar in all respects and appear to constitute a single horizon. Further exploration may show continuity between the Forest Hill occurrence and the chromite horizons of the central part of the district. A gap of about 5 miles lies between them. There is this important difference however: the chrome reefs of the northern section are highly platiniferous, the exposures on Forest Hill averaging 8.2 dwt. platinoids over a width of 2.1 ft., whereas the reefs and lenses which are now being mined for chromite in the central part of the district carry only small fractions of a pennyweight.

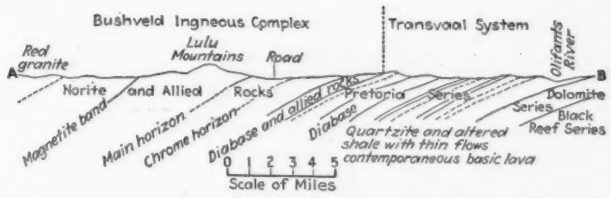


Fig. 3—Section on line A—B, Fig. 2. Lydenburg platinum fields, looking northwest

I shall assume that the orebodies of Class 2 constitute a single horizon, which I shall call the "chrome horizon." This may be described as a 2- to 3-ft. band of feldspathic rock heavily impregnated with chromite and conforming in strike and dip with the pseudostratification of the region. The bands are in general finely laminated parallel to the walls. In places the mass has been sheared and recemented with the carbonates of lime and magnesia. The ore is probably less than half chromite, but its appearance is decidedly black. The dip varies between 10 and 25 deg. southwest. The walls are norite, with coarse crystals of pyroxene and a groundmass of soda-lime feldspar in smaller crystals. This is the typical "spotted norite," by far the most widely distributed component of the basic phase of the Bushveld complex. The hanging wall is for the most part well defined, but the footwall is extremely irregular, platinoid content up to a maximum of about 1 dwt. occurring sometimes over widths as great as 5 ft. underneath the reef proper.

A Reef 75 Miles Long

Outcropping 2,500 ft. to 6,000 ft. southwest of the chrome horizon and about two miles west of the three hortonolite-dunite orebodies referred to under Class 1, is the "upper" or "main" horizon—sometimes called the Merensky reef, in honor of its discoverer—which has been traced with minor interruptions from farm Sterkfontein No. 175 north and northwest a distance of 75 miles to the limit of the Bushveld formation on the north bank of the Olifants River. This horizon comprises the tabular bodies of Class 3, and the indications are that

Trench on chrome reef, Mooihoek

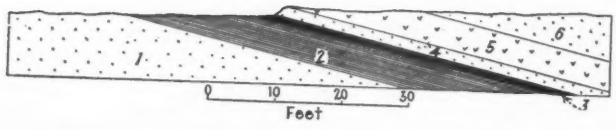


Fig. 4—Section across upper platinum horizon in water-course 750 yd. north of southern boundary of Maandagshoek No. 148

1. Medium-grained spotted norite. 2. Pseudoporphyritic feldspathic pyroxenite, merging upward into 3, which is a pseudoporphyritic pyroxene-rich platinum-bearing norite. 4. Light-colored spotted norite. 5. Mottled anorthosite. 6. Coarse-grained spotted norite.

all of them will prove to be links of a single chain. If it be postulated that 3 dwt. of platinoids to the ton constitutes ore, then this is the most persistent lode occurrence of any metal anywhere in the world. Material of this grade seems to be regarded in the light of platinum ore, there being several strong companies with an aggregate capital of many million pounds sterling appropriated for the exploration and development of this 75-mile line.

I turn once more to Dr. Wagner for the geology and mineralogy of the main horizon:

"The upper horizon is situated some 1,600 feet[5] above the lower. In it platinum is found in a very persistent sheet or layer of dark-colored, pseudoporphyritic, pyroxenitic diallage norite, of variable grain and composition, that originally contained small amounts of copper and iron pyrites, now represented at the surface by malachite and limonite. . . . Platinum has also been found in several localities in rocks some little distance below and above the upper horizon.[6]

. . . . . .

"The sheet varies in thickness from 3 to 40 ft. Where it is very thin, platinum appears to be distributed throughout its entire thickness. As a rule, however, it is concentrated in its uppermost portion. Copper and iron stains are confined to the platiniferous portion of the sheet. These stains owe their origin to the oxidation of grains of chalcopyrite, pyrite, and probably also pyrrhotite. It is thus apparent at the outset that there is some relation between the distribution of the platinum and that of the sulphides.

"The platiniferous norite is exposed at intervals all the way from Twickenham No. 336 to Sterkfontein No. 221[7], a distance of over 50 miles[8]. From the southern part of Hackney No. 337 to the southern boundary of Maandagshoek No. 148 the outcrop of the sheet can be traced practically without a break. It is also exposed on Onverwacht No. 330 and Eerste Geluk No. 348, but at the time of the writer's visit no systematic attempt had been made to trace the outcrop between Maandagshoek and Dwarsrivier No. 86[9], situated south of the Steelpoort, where it is again greatly in evidence. On some of the farms in this gap the location of the outcrop will be difficult owing to the presence of a considerable thickness of soil and alluvium.

"South of Dwarsrivier No. 86 the outcrop can again be traced almost without a break to Sterkfontein No. 221[7], a distance of some 16 miles. . . . In the southern part of Dwarsrivier No. 86 and on Thorncliffe No. 217 the outcrop takes a turn to the southeast, but south of the latter farm it runs almost in a straight line, due north and south, down the western side of the valley of the east fork of the Dwars River to within a few miles of the source of that river on Sterkfontein No. 221.[7]

"The important question arises whether there is here a single sheet or a succession of sheets of norite. This question cannot be answered definitely at present. What can be said, however, is that over very considerable distances the rock keeps to practically the same horizon, that for stretches of well over 2,000 yards it can be followed without a break, and that specimens taken from the southern part of the area are indistinguishable from those taken from the northern part.

. . . . . .

"The upper part of the sheet of dark-colored diallage norite has, wherever properly tested, been found to carry platinum in amounts ranging from a trace to 7.5 dwt. per ton. Over fairly considerable stretches the platinum content has been proved to average between 2 and 3 dwt. and over shorter stretches more than 3 dwt. per ton. The platinum is present in the free state in minute grains and specks, which can easily be isolated by panning the crushed rock. The platinum content of the norite can be estimated fairly accurately by the length of the tail which it gives in the pan. . . .

"The platinum is on the whole much finer than that from the dunite zone, and, speaking generally, is of a yellowish color. Bright silvery-white and dull-grayish specks are, however, often seen in the pan alongside the yellowish grains, so that it is probable that different combinations of the platinum metals are present. . . . In addition to platinum, the norite carries small amounts of gold. This averages about 5 per cent by weight of the platinum metals present. No well-formed crystals of platinum have so far been noted from this horizon."

The rapidity with which the Merensky reef was traced over long stretches devoid of prominent outcrops amazed me until I had studied the district a few days. It then appeared that following the reef was not as difficult as one might think. From to 2 to 30 ft. above it, measured perpendicular to the pseudostratification of the region, there occurs, as far as I know throughout its 75-mile extent, a band of light-colored mottled anorthosite up to 50 ft. in thickness. The relationship of this band to the reef proper is well shown in Fig. 4. Its mottling appears to be due to agglomerations of dark pyroxene crystals, surrounded by white feldspar. Agglomerations noted are more or less circular and up to 2 in. in diameter. The pyroxene crystals themselves have a shadowy look which suggests that they were caught in the act of dissolving in the groundmass when the magma cooled. The mottled anorthosite is light-colored and highly resistant to weathering. It therefore offers itself as a valuable marker for the main platinum horizon.

Main Horizon Proved to Depth of 700 Ft. on Dip

A description of the main horizon on farms Hackney No. 337 and Forest Hill No. 342 will serve for its entire length. Over the greater part of Hackney the outcrop is concealed by a considerable depth of soil and talus, but core drilling has demonstrated the existence of the reef. Incidentally one of the holes on this farm has proved the main platinum horizon to the greatest depth so far attained in the Lydenburg district, about 700 ft. measured on the dip. The core assay at this depth compares not unfavorably with the results of groove sampling close to the surface where the reef outcrops on the southeastern part of the farm.

Near the boundary of the two farms and for a distance of 3,000 ft. southeastward into Forest Hill the Merensky reef can be traced along the northeast base of a spur of the Lulu Mountains. The outcrop here rises to a maximum height of about 100 ft. above the general level of the plain. The average dip at the surface is 15 to 20 deg., but a steepening to 30 deg. or more is generally encountered with depth. Pyrite, chalcopyrite, pyrrhotite, and probably pentlandite are finely disseminated through the 4 to 5 ft. of reef matter lying next

[5] Measured perpendicular to the pseudostratification. A.W.N.

[6] A few other tabular platiniferous occurrences have been noted in the neighborhood of the upper horizon, but they are so far relatively unimportant. A.W.N.

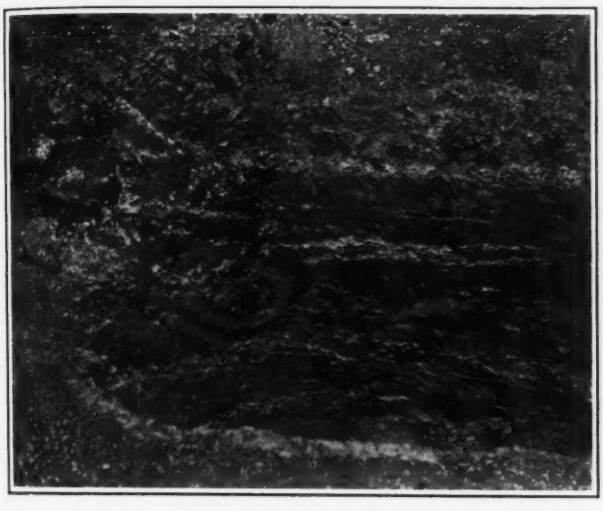
[7] This number appears as 175 and as 1175 on various maps. I have used the number 175 to designate this farm. A.W.N.

[8] It has since been exposed over long reaches between Twickenham and the Olifants. A.W.N.

[9] This has since been done. A.W.N.

the hanging wall. This is the payable part of the reef —about 30 per cent of its apparent average width. Oxidation extends to a depth of about 50 ft. A second reef[10], overlying the main reef and separated from it by one to three feet of spotted norite, has been cut at several points on Forest Hill. The rock of this "bastard reef" is a dark green diallage norite, distinguishable only with difficulty from the ore of the main horizon. Pyrite is present in parts of it, but copper, nickel, and the platinoids are lacking.

I visited Forest Hill early in November, 1925, and had access to all data which were available at that time. In the *Engineering and Mining Journal-Press* for Feb. 13, 1926[11], the Johannesburg Letter under date of Jan. 5, 1926, makes the following statement in regard to this area:



Chrome reef, Forest Hill. Pick marks approximately the hanging wall. Reef is about 2 ft. wide

". . . On Forest Hill, a section 3,000 ft. long has been developed by incline shafts to depths varying from 157 to 310 ft. The consulting engineer, C. B. Kingston, reports that the ore thus partly exposed gives an average assay value of 3.65 dwt. per short ton.[12] A small concentrating plant is being installed for testing purposes. . . . On resampling assays varied between 4 and 6.4 dwt. The total footage to date is: Shafts, 2,493 ft.; trenches, 1,611 ft.; drives, 214 ft., and adits, 540 ft."

Reef Near Hanging Wall Almost Barren

One curious fact relative to the mineralization was brought out by the resampling above referred to. That part of the reef immediately adjacent to the hanging wall and extending downward from it to a width of 0.5 to 0.8 ft., is almost barren of platinoids. This band was probably omitted at the time that the faces were resampled.

A similar condition has been reported from farm Eerste Geluk No. 687 on the north bank of the Steelpoort and from certain workings in the southern part of the district. From what I saw of the main horizon, it will be a difficult matter to keep this upper slice separate while breaking ore. Also the footwall of the pay streak is so irregular that a large amount of sampling and panning must be done while mining operations are in progress.

It might be well to include under Class 3 a mineralized band, 1 to 1.5 ft. thick, which has been traced at intervals for about 10 miles through farm Klein Nooitgedacht No. 199 and the southern half of Steelpoort Park No. 1076. Pyritization accompanied by platinoid deposition occurs along the upper edge of the spotted norite and in places enters the overlying mottled anorthosite. The occurrence is about 9 miles west of the outcrop of the main horizon. Prospecting of this horizon was carried on during the latter part of 1925, but as yet there are no showings that may be considered comparable to those of the main reef.

Transvaal Assays Are Reported in Terms of Platinoids

I have used the word "platinoids" to denote metals of the platinum group as listed by Professor Kemp at the beginning of his article, preceding mine in this issue. The determination of platinum alone is a difficult and complicated one, and custom assays in the Transvaal are always reported in terms of platinoids. A few determinations of the separate metals have been made, however. The platinoids of the Onverwacht dunite pipe are reported to contain 98.3 per cent of platinum. One assay of platinoid concentrate from the main horizon showed:

	Per Cent		Per Cent
Platinum	73	Osmium and iridium	2
Palladium	20	Other platinoids	4

(*To be continued*)

Load Ratio Control in Copper Refinery

By the use of transformers equipped with load ratio control, a Belgian copper refinery will control the current used in its electrolytic processes by varying the voltage applied to a rotary converter, and without interrupting the circuit. By this method the Oolen refinery of the Société Générale Metallurgique de Hoboken will be able to exercise remote control of its processes by means of two push buttons which are located on the control panel.

The installation will consist of two 915/1,840-kw., 750-r.p.m. synchronous converters and two oil-cooled transformers rated 2,055 kva., together with necessary switch gear. This equipment will be installed in a new refinery in Hoboken, Belgium, where copper from the Belgian Congo will be brought and refined. All the electrical equipment will be of General Electric manufacture, and that company is now also building three 4,000-kw. motor generators for a large leaching plant in the Belgian Congo, a subsidiary of the Société Générale Metallurgique.

The Belgian transformers will take their power from a three-phase, 6,600-volt, 50-cycle circuit and will deliver 5,270 amp. to the rotary converters at a pressure which can be varied from 66 to 130 volts in nine steps. Finer adjustments in the direct-current voltage will be obtained by field control.

The motor drive of the load ratio control will accomplish one complete tap change in about ten seconds. It will be possible to operate the tap-changing mechanism by hand, with the motor disconnected. On the switchboard there will be an indicating instrument to show the attendant or operator on which tap the transformer is operating.

[10] This is not typical of the district as a whole.
[11] E. & M. J.-P., Vol. 121, p. 300.
[12] The correspondent neglected to mention the average width over which these samples were taken. It is probably about 4.5 ft.

Apron Feeders at Inspiration, Arizona

Faults of Older Types Eliminated in New Design Adapted for Heavy Duty on Coarse Mine Ore—Manganese Steel Used in Construction

By George J. Young
Associate Editor

FOR HANDLING large tonnages in the mining industry, certain types of mechanical ore feeders have been developed, principally for feeding coarse ore to rock breakers. The commonest type is the apron

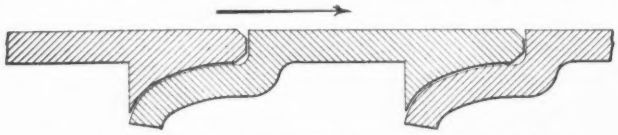


Fig. 1—Section of platens showing type of joint

conveyor. This has the important advantage of permitting easy access to the ore stream, and it is thus practicable to remove tramp wood, waste rock, or rich ore.

Six feeders of the apron conveyor type were recently installed at the Inspiration mine, at Inspiration, Ariz. Two of the feeders are installed on the 12th level of the Inspiration Porphyry shaft and are used to deliver ore from the bins to the weighing hoppers from which the skips are loaded. Four are installed in the coarse-crushing plant, feeding the primary breakers. All of the feeders are identical in design and differ only in

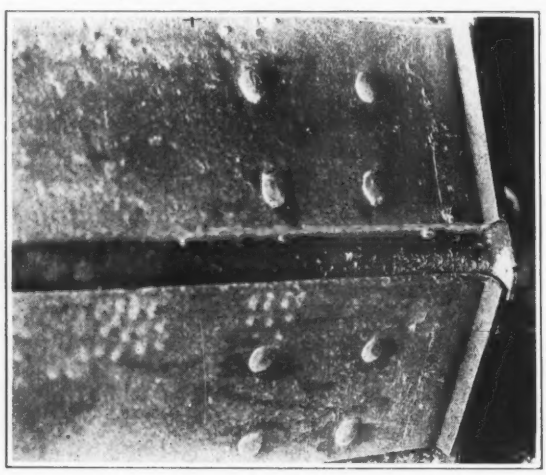


Fig. 2—Condition of joint between platens as they pass around the return sprockets

length, the underground feeders being 7 ft. 6 in. between sprocket centers and those in the coarse-crushing plant 42 ft. 6 in.

The feeders were designed by Corey C. Brayton, of the American Manganese Steel Co., in co-operation with the engineering staff of the Inspiration Consolidated Copper Co. As all worked together to eliminate faults in the mechanical construction of feeders of this type and to perfect a machine that would serve with a minimum of repairs and trouble, the result of their effort is worth detailed study. Similar all-manganese steel feeders had been designed before by Brayton, but the Inspiration feeders were much larger than those at other places.

Most important parts of the apron plate feeder are the platens, which form the table or apron supporting the ore stream; the links, which support the platens and which pass over pairs of sprocket wheels at both ends of the travel; the rollers, which support the links and reduce friction; the sprockets; the skirt boards or cheek plates, confining the ore stream at the sides; and the driving mechanism. There are important features in the design of each of these parts.

The first condition imposed by the designers was a flush-top table or apron. This requirement was occa-

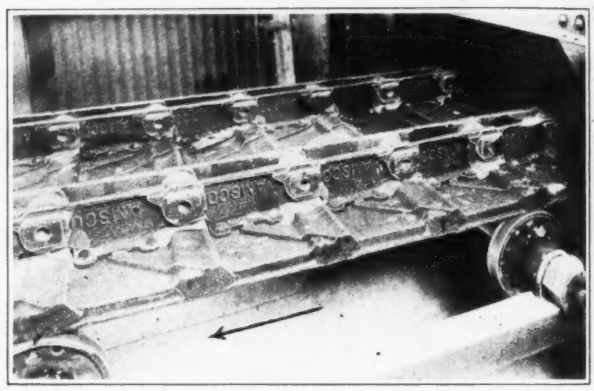


Fig. 3—Appearance of underside of platens, showing links, pins, rollers, and diagonal ribs

sioned by the presence of tramp timber in the ore. A timber standing on end might strike an obstruction, and then by keying into a projection upon the apron would either stop the conveyor or break some part of

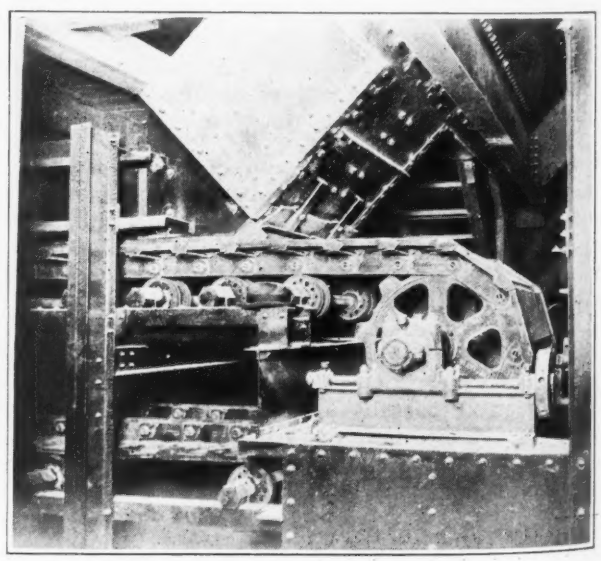


Fig. 4—Take-up end of feeder, showing bin chute, sprockets, links, platens, and rollers

the mechanism. The platen was therefore designed without projections except for a shallow edge at the sides. The knuckle joint shown in Fig. 1 was arranged to give a minimum overlap of 1 in. as the platen passed the sprockets, Fig. 2. This arrangement reduced leakage through the platen-overlap to a minimum.

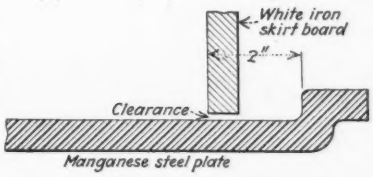


Fig. 5—Position of cheek plate in relation to edge of platen

To facilitate the automatic removal of leakage material, the bottom of the platen is provided with several diagonal ribs shown in Fig. 3. These direct the leakage material (what little there is) from the center outward as the platen returns over the sprockets at the tail end of the feeder. Thus the platens are in a measure self-cleaning, and accumulation of material on the return side of the feeder is avoided. As will be noted from the sketch of the platen overlap joint, there is little opportunity for leakage, as the joint clears itself in passing over the head end (feed discharge) of the machine.

A pair of links is riveted to each platen as shown in Figs. 2 and 3. The links are of one-piece construction and are joined to the links of the next platen by 2-in. hollow pins, which are fitted with a tight head to prevent rocking. The hollow pins and keys are shown in Fig. 4. To prevent the links from sagging between the rollers upon which the links run, horns are provided at the end of each link on either side. These bear against a lug on the contiguous link and form a knee joint, which can bend in one direction but not in the opposite. The effect of the horns and lugs is to make a rigid bar of the link chain as it passes along both lines of travel. The flatness of the apron is thus maintained at all points. The weight of the table and its load are supported upon rollers, as shown in Fig. 4, several of these having riveted flanges so as to maintain the alignment of the table. All of the rollers are cast from one pattern and have a flat tread.

On the loaded side of the long feeder nineteen sets of rollers are used and on the return side there are ten sets. The rollers are placed closer together beneath the receiving chutes. Links rest directly on rollers, which are keyed to 2-in. shafts. On the return side the turned-up edge of the platens rests upon the rollers. Rollers, links, pins, and platens are manganese steel.

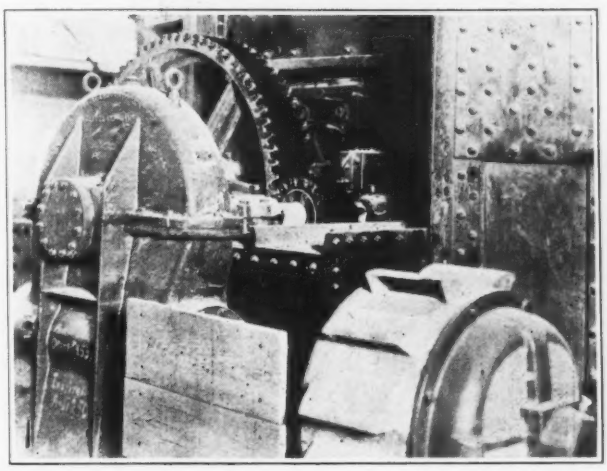


Fig. 6—Feeder drive, showing motor worm gear, pinion, and driving gear

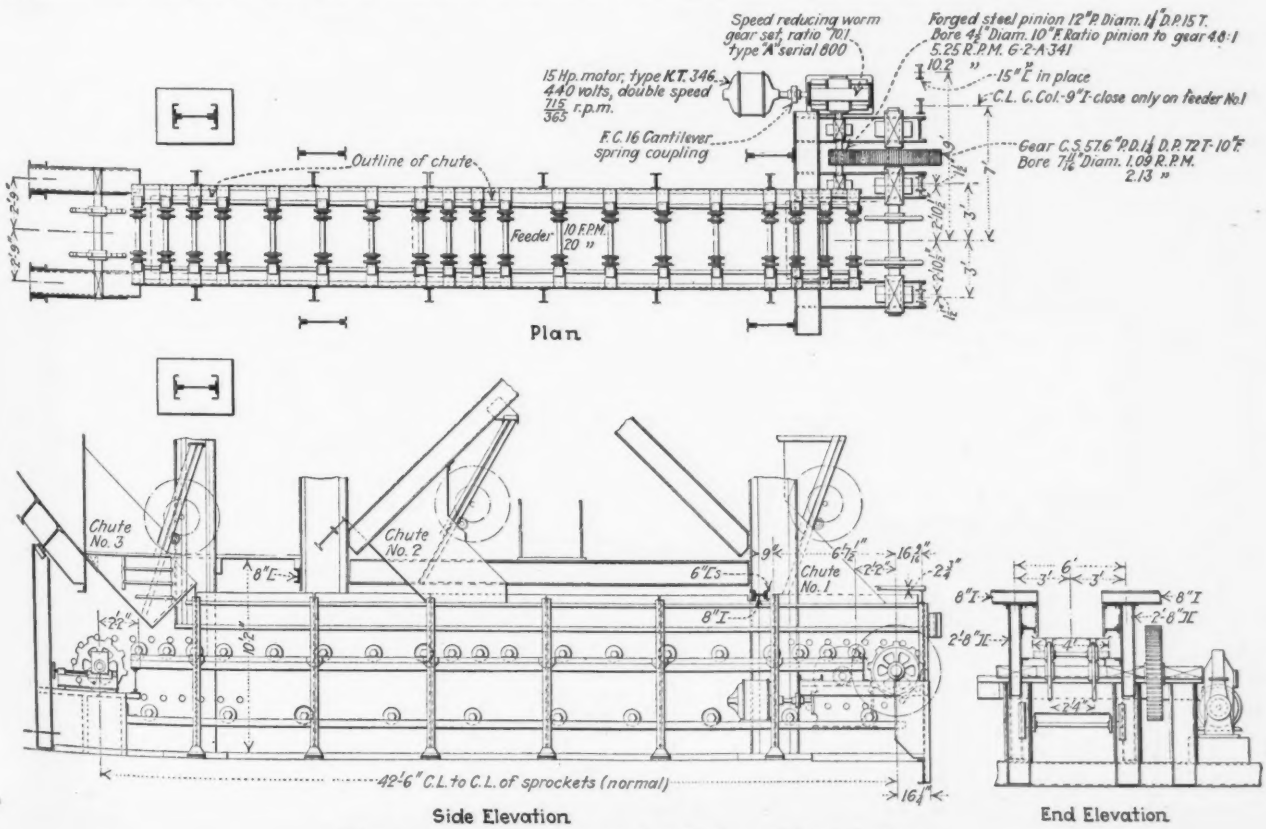

Speed reducing worm gear set, ratio 701 type "A" serial 600
Forged steel pinion 12" P. Diam. 1¼" D.P. 15 T. Bore 4½" Diam. 10" F. Ratio pinion to gear 46:1 S. 25 R.P.M. 6-2-A-341
15 Hp. motor, type K.T. 346, 440 volts, double speed 715 365 r.p.m.
F.C. 16 Cantilever spring coupling
10.2 "
15" L in place
C.L. C. Col.-9" I- close only on feeder No. 1
Gear C.S. 57.6" P.D. 1¼ D.P. 72 T- 10" F. Bore 7⅛" Diam. 1.09 R.P.M. 2.13 "
Outline of chute
Feeder 10 F.P.M. 20 "
Plan
Chute No. 3
Chute No. 2
Chute No. 1
8" L
6" L
8" I
9"
6-1/8"
16¼"
2-2"
2¾"
42'-6" C.L. to C.L. of sprockets (normal)
16¼"
Side Elevation
End Elevation

Fig. 7—Plan, elevation, and end view of long feeders

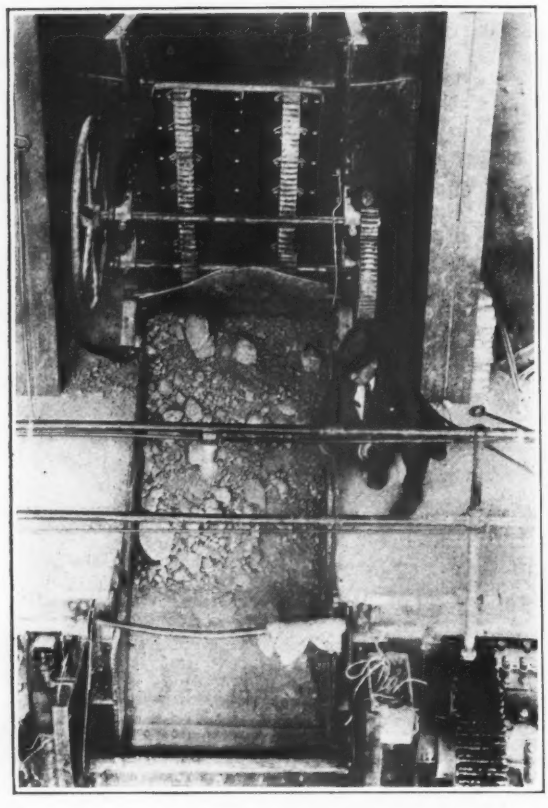


Fig. 8—Looking down upon feeder at discharge end. Chute gate for controlling ore flow is also shown

Skirt boards, or stationary cheek plates, are white-iron plates set with just a bare clearance above the apron and inset 2 in. from the outer edges of the platens. They confine the ore stream and prevent spillage at the sides. Fig. 5 shows the relation of cheek plate and platen.

The sprockets are constructed of manganese steel. Return sprockets are mounted upon take-up bearings, shown in Fig. 4. Head sprockets are mounted on a 7½-in. shaft driven by a spur gear of 10-in. face width. The pinion shaft is driven by a worm-type reduction gear connected by a flexible coupling to a 15-hp. motor, which will operate at two speeds, 365 and 715 r.p.m., giving two feeder speeds, respectively 10 and 20 ft. per minute. The driving gear is shown in Fig. 6. Push-button control enables the feeder to be started and stopped quickly. The assembly of the long feeder is shown in Fig. 7. The discharge end of the feeder and the control gate on the ore chute are shown in Fig. 8. Chains or links require no lubrication, but the roller shafts are conveniently and effectively lubricated. As will be noted in Fig. 4, the roller shaft boxes are hexagonal so as to admit of turning to new positions as they become worn.

The width of the platen is 4 ft.; the clear width between cheek plates is 3½ ft.; and the maximum thickness of ore stream is 2 ft. Maximum load is 7 cu.ft. per foot of length, or about 0.35 tons. Maximum live load on the apron would be 7 tons if loaded to the maximum height of ore stream over a length of 20 ft. The capacity, assuming a depth of 2 ft., would be 3.5 tons per minute at a speed of 10 ft., and 7 tons at a speed of 20 ft. per minute. The average maximum load delivered by one of the crushing plant feeders is 300 tons per hour, but during the time of operation the feeder is stopped and started many times to allow the picker to remove timbers and to prevent overloading the gyratory crusher. Depth of ore is controllable within certain limits by the chute gate opening, which is regulated to correspond to the capacity of the primary crushers.

Power requirements for the crushing plant feeders are as follows:

Power Requirements

	Twenty Feet per Minute		Ten Feet per Minute	
	Empty Horsepower	Loaded Horsepower	Empty Horsepower	Loaded Horsepower
Motor input...	5.36	7.50	3.43	4.29
Motor output.	4.29	6.00	2.74	3.43

The short apron plate feeders installed underground at the Porphyry shaft are operated at a speed of 40 ft. per minute, and can supply a skip load, or 12 tons, of ore in about one minute. Operating at 40 ft. per minute the motor input for the Porphyry mine feeder is 3.21 hp. empty and 3.75 hp. loaded.

George H. Booth, mechanical engineer for the Inspiration Consolidated Copper Co., described the installation at the Porphyry shaft in *Engineering and Mining Journal-Press* of March 21, 1925. Details of power requirements of both feeders were given to me by Mr. Booth, who also informs me that they have been in operation for more than one year without replacements or repair work.

Sullivan Orebodies Large

A. J. Langley, Resident Provincial Engineer for No. 5, or the Kootenay, Mineral Survey District of British Columbia, is authority for the following statements about the ore deposits at the Consolidated Mining & Smelting Co.'s famous Sullivan mine: The south ore deposit has been developed for 700 ft. along its strike; it averages between 30 and 40 ft. in thickness. The north ore deposit promises to be much greater in extent, and in places has a thickness of 200 ft. Mr. Langley describes the orebodies as displacement deposits in quartzite, composed of a dense crystalline mixture of sulphides of lead, zinc, and iron, averaging about 11.5 per cent of lead, 10.5 per cent of zinc, and three ounces of silver per ton.

Inspiration Concentrator Results

Mill statistics reflecting the operations of the Inspiration Consolidated Copper Co. for 1925 are as follows:

Ore milled, tons	5,053,216
Ore treated per day of milling operations, tons	14,037
Average number of sections running	14.9
Average rate per section, tons	940
Screen analysis of mill feed to concentrating machines (on 48 mesh), per cent	3.8
Assay of mill feed—total copper, per cent	1.033
Oxide copper in mill feed, per cent	0.177
Assay of general mill tailings, per cent	0.215
Oxide copper in general mill tailings, per cent	0.166
Smelter assay of concentrates produced, per cent	35.183
Assay of flotation concentrates, per cent	38.07
Assay of table concentrates, per cent	3.94
Moisture in general concentrates, per cent	8.23
Tons of ore required to produce one ton of concentrates, tons	42.5
Recovery of copper in milling, per cent	
Calculated from assays only	79.67
From assays and weights of concentrates and ore	80.19
From assays and weights of concentrates and tailings	79.78
From assays and weights of ore and tailings	79.67
Recovery of copper sulphides in ore, per cent	94.41
Fresh water used per ton of ore ton	1.234
Power used per ton of ore milled, kw.-hrs.	
Coarse crushing	0.46
Fine grinding and concentrating	10.30
Blowers for flotation air	1.75
Filtering and reclaiming water	1.00
Lighting	0.14
	13.68
Steel ball consumption in fine grinding, per ton of ore milled, lb.	1.55

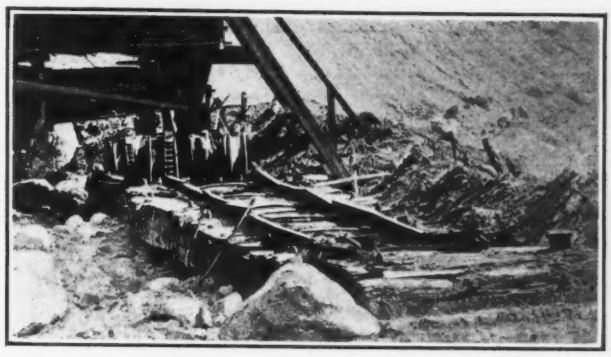
Useful Operating Ideas

Timber Mats Aid Track Laying for Electric Shovel

By Oliver O. Ormond
Superintendent, Wabigon Mine, Buhl, Minn.

Track laying ahead of the 350-ton electric shovel in the Hanna Ore Mining Co.'s Wabigon open pit, on the Mesabi range, is facilitated by the use of timber mats 8 x 14 ft. in dimensions to which corresponding lengths of track consisting of 130-lb. rails have been spiked. There are ten of these mats to a shovel, and they take the place of the longer sections of track formerly used. Four or five pit men were needed to carry the sections forward from behind the shovel. The mats require only two pit men. They are picked up by the shovel, swung around to the front, pulled back into position by means of a cable, and connected up by the men. Some of the mats can be seen in the accompanying photo.

The mat consists of three layers of timber bolted together thus: The bottom layer has twelve 8 x 8 in. x 14 ft. timbers tied or bolted together with four 1⅛ in. rods. On this are laid twenty-one 6 x 8 in. x 8 ft. timbers placed at right angles to the timbers underneath. This second layer is bolted together with three rods. The two layers are then bolted to each other with about eighteen ¾ x 14-in. bolts with countersunk heads. Planking is then spiked to the upper layer of 6 x 8 in. timber. Sixteen 3 x 10 in. by 8 ft. planks plus a 4-in. strip are required. The planking is laid parallel with the layer immediately below it. A 1¼ in. round U-bolt is set in each corner of the mat to permit it to be handled by the shovel.



One of the tracks on which the 350-ton electric shovel moves. It consists of timber mats carrying short lengths of rail as described

Recent Powder Magazine Construction

By C. E. Mills
Chief Engineer, United Verde Copper Co., Jerome, Ariz.

Two magazines for storage of explosives have been recently constructed by the United Verde Copper Co. at Jerome, Ariz. One of these is situated 3,000 ft. from the portal of the Hopewell tunnel and is used to store explosives for the mine. It is of wooden construction, covered with corrugated iron, the walls being filled with a 1:8 mixture of cement and sand. The plan, elevation, and section are shown in Fig. 1.

As originally designed, frozen powder was thawed in a small 8 x 8-ft. room heated by electric grids placed in a small concrete housing 15 ft. distant from the magazine, and connected to the thawing room by a concrete duct. Natural ventilation was depended upon for heat distribution. The old heating unit was below track grade and the encroachment of a waste dump necessitated its removal. The new layout consists of a set of three electric grids inclosed in a concrete housing 20 ft. distant from the magazine. Air is forced over the heated grids by a No. 3 Ventura disk-type fan and passes through a 100-mesh screen and over a bath of water. The screen prevents sparks or hot dust particles from entering the magazine and the water eliminates any possibility of static electricity accumulating in the dry air. Air enters the old thawing room and is distributed to the main portion of the magazine through vents in the wall. A slat partition prevents powder from being piled against these vents.

The second magazine replaced the two magazines

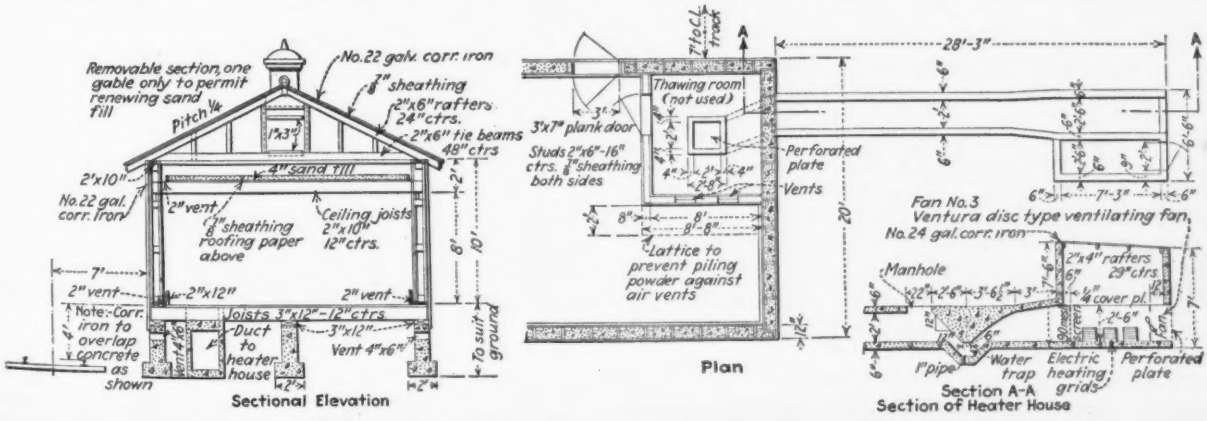


Fig. 1—Plan, section and elevations of United Verde powder magazine

destroyed on Dec. 20, 1925, at Hull Springs, on the abandoned U. V. & P. R.R. grade about three-quarters of a mile from the open pit. They were 9 x 20-ft. inside measurements, with a circular arch roof. The walls were 18 in. thick at floor line, 12 in. at spring line, and 6 in. at center of arch; the spring line was 6 ft. above floor line, giving a 10-ft. 8-in. inside height; the end walls were 12 in. thick; the floor was a 4-in. concrete slab laid directly on the ground. The door was constructed of ¼-in. plate with wooden door frame. No reinforcing steel was used and all concrete was a 1 to 7 mixture of cement and sand. The magazines were well designed and the explosion proved the desirability of this type of construction, as no large pieces were thrown when the 950 boxes of powder exploded in the upper magazine.

The new magazine, represented in Fig. 2, replaced the

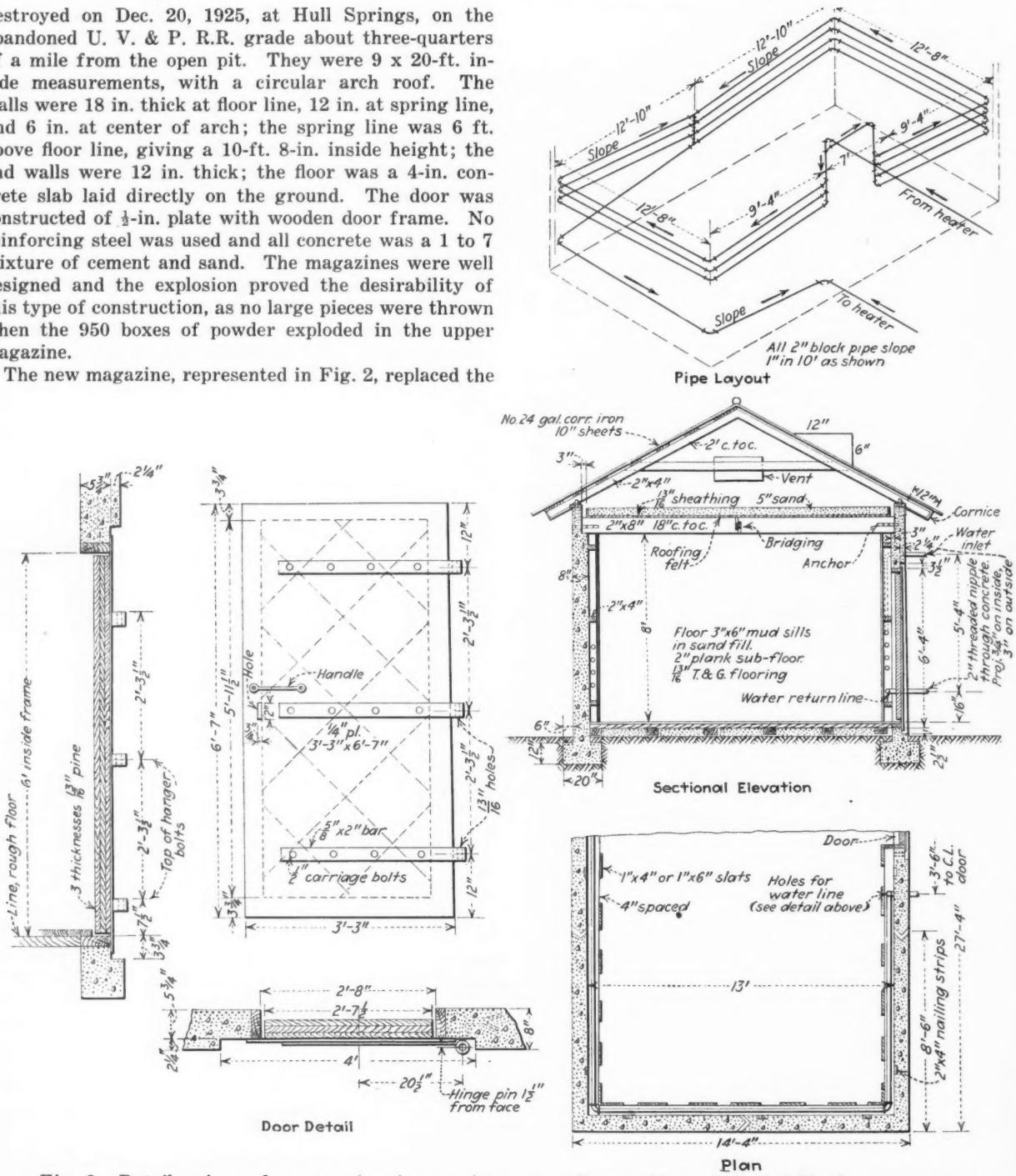


Fig. 2—Details of powder magazine for serving open pit operations at United Verde copper mine

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Special attention was given to safety in heating the magazine, and for this purpose a hot-water system was selected. All inside piping is hung from the walls and entirely covered with vertical wooden slats to prevent piling powder against heating coils. The heating tank is equipped with three 3,000-kw. Everhot immersion type electric heating units, each unit being on a separate switch to provide heat control for varying outside temperatures. The heating plant is housed in a well-insulated shed 20 ft. distant from the magazine, thus preventing any sparks reaching the storage room.

Automatic thermostat control with inclosed contacts was considered in connection with both magazines, but discarded in favor of hand control. Each magazine is provided with a recording thermometer. The powder foreman is responsible for the temperature maintained within the magazine and he endeavors to keep the range between 60 and 70 deg. F.

Discussion

California's Blue-Sky Law

THE EDITOR:

Sir—I have read with interest a letter published in your issue of April 10, 1926, from Edwin M. Daugherty, Corporation Commissioner of the State of California, on the subject of the blue-sky law of this state. With his last statement, "It is and has been the desire of the California Corporation Department to encourage legitimate mining enterprises, and this policy will continue," I take most emphatic exception. As a matter of fact, every possible hindrance has been, is, and doubtless will be placed in the path of the promoters of such enterprises. Things have reached such a pass that California is shunned by mining capital.

The proof of each pudding is in the eating. Metal production of this state has fallen off 23 per cent since this law was adopted, and is declining seriously each year. The average yield for the last eleven years was $29,666,722. Last year production reached but $22,893,500, or $6,773,222 below that average. Gold production has fallen off 36.2 per cent since 1913, and 42 per cent since this state set up an individual to decide whether or not men are honest, or their mining projects good, bad, or indifferent. Oregon, the only other Western state with a similar law, shows a decline of no less than 81 per cent since its adoption.

To men who believe in preservation of the American form of government, a law which gives one man the power to say whether or not a mining project is legitimate is most objectionable. There are no hard-and-fast rules to govern the commissioner in this state. He may deny a man the right to do business within the state without stating his reasons, and if that man seeks redress in the courts, the order of law is reversed. In other words, the plaintiff is considered guilty until he proves himself innocent. I wonder if your publication really intends to endorse such un-American legislation, as it seems to have done in recent editorial utterances.

Impounding of stock in incorporated companies is merely escheatment of an individual's possessions. Surround it with any altruistic motives you see fit, and that fact will still remain. It means that a prospector who spends years in the desert seeking a likely prospect, and who transfers his property to a stock company, is deprived of the only asset it has been possible for him to earn. In other words, the Corporation Commissioner "encourages" him, and therefore the mining industry, by putting him on the street. Prospecting and development of new mines cannot go on under such conditions. If the purpose of impoundment is, as I suppose, to prevent men from selling individual stock in the guise of treasury stock, it would be far easier, fairer, less destructive and more efficacious to identify each class of stock plainly.

Evidently you have not studied this act. If you had, you might agree with my conclusion that it is unconstitutional from one end to the other. It most certainly is strangling honest initiative in this great state. I am a member of the Mineral Industry League, recently organized to bring about modification of the law, and, from the enthusiasm with which it is being received, it is very evident that the mining fraternity is practically unanimously in accord with my estimate of California's blue-sky law. Either it must go, or the mining industry. One or the other.

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I have been consulting engineer for a number of lode tin mines in Australia (and Tasmania), and this statement makes my mouth water. In Australia a 2 per cent mine would be a very rich one. The Bischoff mine, which was for years the world's largest lode tin mine, had a return for many years of not much over 1 per cent and is now glad of 0.50 per cent oxide (or about 0.70 and 0.35 per cent metallic tin). This mine has a paid-up capital of £30,000 and has paid over £2,000,000 in dividends.

The Anchor mine, of which I was general manager for eleven years, worked a hard granite ore. In that period the ore was worth about 3 lb. metallic tin per ton, or about 0.14 per cent, and the recovery 2 lb., or about 0.1 per cent. Our assay of concentrates was about 71 per cent.

Thus, what is lost at the Llallagua plant, 1.82 per cent, would make, with us, a mine richer than any we have got. What is lost at the Huanimi, the poorest of the Bolivian mines quoted, is equal to three times the value of our ore at the Anchor mine. Had it not been for an erratic water supply, the mine would have still been running and earning handsome dividends. In the only year in which the water supply was constant, 153,738 tons was crushed, at a cost of 2s. 3.68d. per ton, for a return of 3s. 9.11d. per ton (2.206 lb. metallic tin per ton), leaving a profit of about £11,000. The average price of tin was £190 17s. 14d.

Nowadays, Bolivia holds the second place as a tin producer, and Australia has fallen from the third to about the sixth place, and since the present worked alluvial mines are approaching exhaustion, and little interest is taken in lode mining, it seems likely to disappear altogether as a tin producer.

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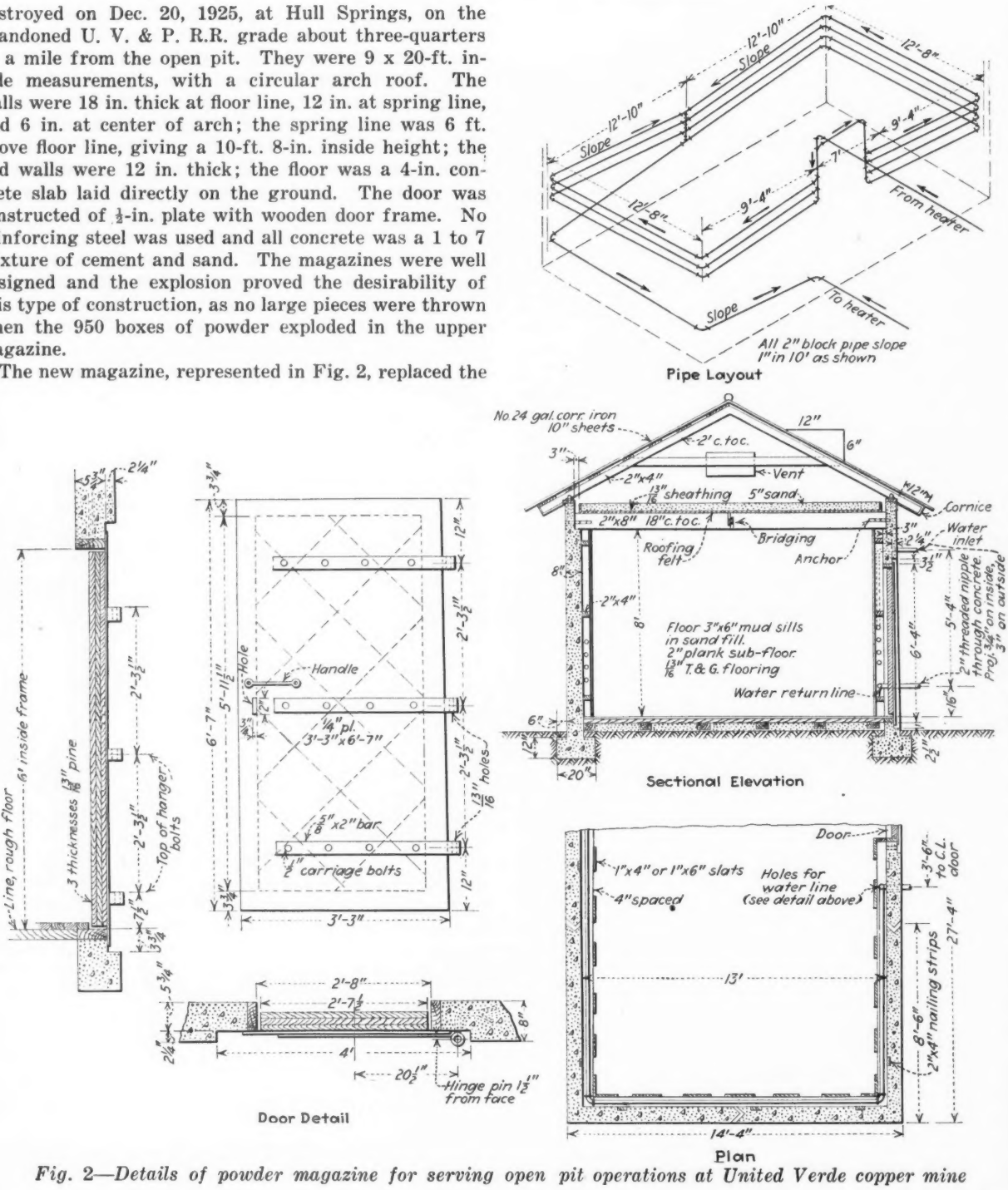
destroyed on Dec. 20, 1925, at Hull Springs, on the abandoned U. V. & P. R.R. grade about three-quarters of a mile from the open pit. They were 9 x 20-ft. inside measurements, with a circular arch roof. The walls were 18 in. thick at floor line, 12 in. at spring line, and 6 in. at center of arch; the spring line was 6 ft. above floor line, giving a 10-ft. 8-in. inside height; the end walls were 12 in. thick; the floor was a 4-in. concrete slab laid directly on the ground. The door was constructed of ¼-in. plate with wooden door frame. No reinforcing steel was used and all concrete was a 1 to 7 mixture of cement and sand. The magazines were well designed and the explosion proved the desirability of this type of construction, as no large pieces were thrown when the 950 boxes of powder exploded in the upper magazine.

The new magazine, represented in Fig. 2, replaced the



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lower than in Australia, and the management is probably quite as efficient as ours. It could be even more efficient without being anything wonderful. Wasn't it a great American authority who said that Australian mines were the worst managed in the world?

JAMES B. LEWIS.

East Malvern, Victoria, Australia.

Against the Metric System

THE EDITOR:

Sir—The letter from Mark R. Lamb on the "Metric System" published in your issue of March 27 interests me and seems to the point. I never have seen any good reason for the United States adopting the metric system as its standard of weights and measures. The only advantage that the metric system has over our system of measures is that it is on a decimal basis, and we can get the advantage of that without adopting the meter as a basal unit.

Some years ago an engineer named Halsey wrote strong articles against the use of the metric system and used the epigram "Distances are irrevocably tied to the past." Thus land originally surveyed and acquired in feet must always be so conveyed, or clumsy conversions must be introduced into the transfer deeds. An 8-in. steel beam is an "8-in. beam" no matter what kind of a measure is legal. Some twenty years ago a certain German firm had not adopted a metric bolt thread and used the Whitworth system because it was standardized. Its drawings showed dimensions in millimeters, using as many as five figures, except for threads; these were marked $\frac{5}{8}\phi$, $\frac{3}{4}\phi$, etc., meaning $\frac{5}{8}$ in. diameter, etc.

Our standard unit of measure of length is a foot; it is just as good a unit as the meter; the foot is used by more people than use the meter, and I see no reason why the majority of *users* should change to suit the minority. I suggest that the world adopt the foot as the standard unit of measure. The only important users of the meter are Continental Europe aside from Russia, while England, Canada, United States, and Australia use the foot.

The only difficulty with our system of measures of length is that we divide the foot into twelve inches, which complicates calculations between inches and feet, but it would not cause any serious trouble gradually to change over to decimals of a foot as the surveyor has done. We could give that unit a special name for use with small distances. The multiples of the foot may be retained or dropped as custom dictates without involving any change or affecting the standard unit; at present, the yard and mile seem convenient, but the "rod, rood, perch, or pole" and the "chain" are passing out for new work, but remain in connection with old layouts. They have direct relation to the foot, and hence are convertible to feet.

In line with the above suggestions our new elementary arithmetics might read:

Measures of Lengths

10 Toes = 1 Foot
100 Feet = 1 Centiped

The "centiped" it will be noted is the railroad surveyor's distance called a "station."

When it comes to weights, the standard used does not leave a lasting impression and the unit used is less important, but it would be desirable if all countries used the same unit. The pound would suit the English-speaking peoples. It could be subdivided decimally; we use its decimal multiple of hundredweight, cwt., at present, and we could easily adopt a thousandweight, mwt., in place of a ton. We should discard the troy and apothecary's weights and drop the long ton, as we have the first part of that table, namely:

14 Pounds = 1 Stone
8 Stones = 1 Hundredweight or 112 lb.
20 Hundredweight = 1 Long ton, or 2,240 lb.

The relation between the weights and measures which occurs in the metric system appeals to its users as so "simple and convenient"; thus I have been told that to get the weight of an object of known metric dimensions one only has to determine the volume from the given dimensions, point off, and multiply by the specific gravity. I asked "Where do you get the specific gravity?" The reply was: "From tables." I then pointed out that we can get the volume, figuring in feet and its decimals, and multiply by the weight of one cubic foot of the substance which we get from tables. The work involved in the two cases is identical unless the substance is pure water, whose specific gravity is 1.

The fact that chemists use metric weights and measures is often advanced as an argument in favor of the metric system, when really all the chemist is interested in is the decimal divisions of the unit, which facilitates the calculation of percentages. The chemist does not care what the unit is, provided its divisions are decimal. The metric system has entered the laboratory because of the decimal feature, the fact that many chemical investigations are of European origin and the operations were based on the metric system, and, as the apparatus was made abroad, the stock sizes were based on the metric dimensions.

For measures of volume we now use cubic feet. Our systems of wet and dry measure are abominably complicated, but are gradually being simplified by custom. Dry measure is giving place, at retail stores, to selling by weight, and the bushels of grain in a lot is determined by weighing; thus dry measure seems to be passing out and probably could soon be dropped.

Liquid measure is needed and could be simplified by adopting the quart or gallon as the unit and building a decimal table from that.

I have used the metric weights and measure of length enough to be familiar with them, and see no advantage in their use over the use of the pound and foot. It is some nuisance to convert our measures into metric, however. I scale metric maps, drawn to a decimal scale, directly in feet by using my scale of one foot divided decimally. I have had little occasion to use the measures based on the liter or our own liquid measure, and so have limited my remarks regarding them.

Briefly, it seems to me that it is a mistake to try to convert the English-speaking nations to the use of the metric system. We have too many valuable standards based on the foot to give it up. Our system can be improved by adopting decimal divisions without affecting the unit and without coercion. Let the *minority users* of measures adopt the foot as a unit whenever they get tired of being out of step with the majority through the use of the meter or of their own national unit.

E. B. DURHAM.

Boston, Mass.

Prospecting in Northern Canada

THE EDITOR:

Sir—The Red Lake find has created a gold rush that is said to be equal to the one to the Northwest Territory, the Klondike, Dawson, and the Seward Peninsula. The first thing a prospector from the United States must do is to obtain licenses to prospect, fish, and hunt. The streams are fairly well stocked with fish. Just what he can hunt is problematic, but there are birds that are not always able to keep out of the way of a charge of shot, and to kill a stray bear or deer to keep from starving is probably admissible. Porcupine and possum are admissible game, and not half bad when properly prepared. I never could fancy them as a steady diet, especially the possum. The other eating supplies are flour and bacon. Ham is too easily worked into food and weighs too much, reducing the supplies to flour, soda biscuits, and pancakes. The prospector in northern Canada need not worry about the heat melting the bacon, as in Death Valley.

The next thing to be considered is the moccasin outfit and material to sicken mosquitoes and black flies. In some parts of the United States when a man gets inoculated by mosquitoes they let him alone. In Canada they do not, but stay with him to the bitter end, from hatching time to freezing time. The drinking water is free from germs and no mountain fever need be feared, or chills and fever, unless pneumonia takes hold.

Red Lake is about 1,200 miles from Toronto and 140 miles from the nearest railway station. However, prospecting is *de luxe* compared with the Northwest Territory, as airplanes can be hired at Detroit and Buffalo to take one to the lake in a little over a day. The next duty of the prospector is to hire an Indian cook and guide, or depend on getting lost, half starved, and worn out. This is a camping-out proposition, where travel is by canoe. The Indians are better paddlers, carriers, and canoemen on land and water than white men. The streams have rapids, which must be walked around.

E. B. WILSON.

Scranton, Pa.

No Axes to Grind

THE EDITOR:

Sir—I have "no axes to grind." I do not know C. C. Julian, nor do I know anyone associated with him. I am not interested in his properties, stocks, or promotions. I am not personally interested in Leadfield, near here. But I am deeply interested in legitimate mining, and I want to see a square deal all around in everything connected therewith.

I have a very high opinion of the *Engineering and Mining Journal-Press*, and of its personnel, and I would like, as I believe you too would desire, to correct any mistaken attitude on its part. With reference to your editorial concerning "Misuse of Newspapers, etc.," in your issue of Feb. 20, 1926, I take exception to certain excerpts, as follows:

Your use of the word "engineers" in quotation points indicates a narrow and an unworthy prejudice. Your assertion that Mr. Charles D. Wilkinson has been interested in minor properties in Nevada is erroneous, misleading, and unjustifiable. It is also a gross injustice to Mr. Wilkinson, and utterly unworthy of a responsible journal like the *Engineering and Mining Journal-Press*.

Your statement that "none of these men are members of the Institute, nor have their names appeared in Who's Who, etc.," is childish, coming from the *Journal*.

Your concluding statement regarding ". . . our whole body of ore is above grass roots" being "sufficient to condemn the promoter and the newspaper" requires substantial qualification. As a matter of fact, I can point to at least one body of concentrating lead ore which shows 11 per cent lead, 5 oz. silver, which stands at least 15 ft. high, over 25 ft. wide, and a little over 300 ft. in length on the ground in Leadfield.

Having lived in this immediate section of Nevada over twenty years steadily I am in a position to back my statement with incontrovertible evidence; and, though I have no connection with any one of the operators in Leadfield today, nor a share of stock in any of their promotions, nor any interest in any claims in that camp, yet I am substantially and deeply interested in the surrounding country, and I deplore any prejudice on the part of the *Journal*.

Inasmuch as large masses of lead ore are found in brecciated lime, accompanied by barite; and also occupying various faults, which are characterized by calcite in many places; and, furthermore, inasmuch as quartz-monzonite intrusions occur near by, would you insist that the whole undertaking is "set forth with unbridled restraint and a cunning disregard of obvious facts"?

Why not qualify your statements to the extent of giving the mining business and the desert country a square deal?

This country is no more inaccessible than one thousand and one other places now pouring dividends into the laps of their stockholders. Why obscure that fact?

The *Engineering and Mining Journal-Press* is big enough, strong enough, ethical enough to correct any injustice it may have unwittingly committed, and I for one earnestly hope you will continue to advocate legitimate mining as you have been doing, and meanwhile be at all times ready to rectify any injustice that may inadvertently creep into your columns. I appreciate the fact that a spirit of fairness prevails in your office, but there are too many little evidences of a counteracting spirit of narrowness.

Beatty, Nev. JOS. D. O'BRIEN.

The Mineral Resources Division

THE EDITOR:

Sir—I noticed your editorial in the April 3 issue of the *Engineering and Mining Journal-Press*, entitled "Wanted Names of Buyers of Minerals and Ores," in which you suggested that the U. S. Geological Survey, Mineral Resources Division, might undertake such a compilation. May I call your attention to the fact that almost a year ago you announced in your journal that the Division of Mineral Resources had been transferred to the Bureau of Mines and that in turn to the Department of Commerce. Evidently someone overlooked a bet.

I think you will also find that if the Mineral Resources chapters are read with any care at all, there is in the text considerable information giving names and addresses of both producers and consumers of the minerals covered by the reports.

J. M. HILL,
Engineer in Charge, San Francisco Section,
Division of Mineral Resources and Statistics.

San Francisco, Calif.

Consultation

Grades and Specifications of Graphite

"We will greatly appreciate it if you can answer the following questions about graphite:

"1. Among the graphitic products on which you quote in the *Engineering and Mining Journal-Press* are Ceylon lump, Ceylon chip and Ceylon dust. We have found in the book entitled 'Marketing of Metals and Minerals' the physical specifications, but would like to know the graphitic carbon contents required for these three qualities?

"2. We understand that the Ceylon graphite is used in this country mainly for the manufacture of crucibles. Is this correct? If not, what are the other industries using this material.

"3. We have found the physical and chemical specifications of the quality quoted in your publication under the name 'Crude Amorphous.' We understand that this grade is not used in this country for the manufacture of crucibles. What is the main use for it?

"4. We have also found specifications of Flake No. 1 and Flake No. 2 grades. Are we to understand from the term 'Flake No. 1 Lubricating,' sometimes used in issues of your publication, that this grade is almost exclusively used for lubricating purposes?

"5. You also quote on 'Extra Fine Ground,' 'Medium Fine Ground,' and 'Facings.' Could you give us the following information in regard to each of these three qualities: (a) chemical specifications, (b) physical specifications, (c) uses, and (d) origin of the raw material from which they are manufactured? Is this raw material crystalline or amorphous?"

There are no exact standards for these different grades and classifications, nor is one product used for a given purpose to the exclusion of all others. However, the following data, from reliable sources, should give a general idea of the situation:

1. Ceylon lump is a sorted product and usually contains about 90 per cent graphitic carbon. Chip ranges around 80 per cent, and dust about 70 per cent.

2. The bulk of Ceylon lump and chip is used for crucible manufacture. Other uses are: lubricants, pencils and paint, foundry facings, stove polish, electrodes and brushes for the electric industry, fillers for dry batteries, and steam boiler mixtures.

3. "Crude Amorphous" is not suitable for crucible manufacture, but will do for the other purposes mentioned above. The most important use from the standpoint of quantity is for foundry facings.

4. Lubricating graphite obviously must be free from grit or the bearings would be injured. It may be of actually higher grade than crucible graphite, or it may be of lower grade; but the impurities must not be abrasive. Preparations designed for lubrication sometimes are used for other purposes, but probably not in large quantity. The grades No. 1 and No. 2 refer to the size of the flakes, but the value does not necessarily depend on this feature. The selection of flake size is often a matter of taste.

5. In these grades the graphitic carbon content may be as low as 40 or 45 per cent for many purposes.

Foundry facings need not be ground particularly fine; but for some uses the product must be so well pulverized that 99 per cent will pass a 200-mesh screen.

The uses are those already enumerated, excepting, of course, the making of crucibles.

The raw material may be imported or domestic; crystalline or amorphous. Amorphous or Ceylon dust is generally preferred for foundry facings, though ground flake also is used.

Prospector's Test for Molybdenum

"Can you give a procedure that the average prospector will find practical in determining the presence of molybdenum and as to whether there is a slight trace or worthwhile quantities?"

In general it may be said that the reactions in the following tests will not be sharp unless there are moderately large proportions of molybdenum. Samples and assays would be necessary, of course, to determine definitely the molybdenum content. These directions are taken from an excellent pamphlet, "Field Tests for the Common Metals," published by the University of Arizona.

"Molybdenum can usually be detected by its reduction to the blue or black oxides of molybdenum.

"To make this test, place in a small porcelain crucible or some other porcelain receptacle a little of the powdered mineral that is to be tested. Use about that amount of powdered mineral that can be held on the tip of a knife blade. Pour onto the mineral about one-half a teaspoonful of concentrated (strong) nitric acid. Heat this mixture strongly to dryness or until all of the acid has been boiled off, and nothing but a dry, white, or grayish residue is left in the bottom of the receptacle. Cool to room temperature, and then pour a few drops of concentrated (strong) sulphuric acid (oil of vitriol) onto the cold residue. Heat again until dense, white fumes of sulphuric acid are given off freely and until only a little of the sulphuric acid remains in the receptacle. Cool again by blowing strongly onto the residue. On cooling a beautiful, deep-blue color develops on the sides and in the bottom of the receptacle providing the mineral used in the test contains an appreciable amount of molybdenum. Beginners practicing this test should use molybdenum, wulfenite, or some other molybdenum mineral.

"Molybdenum can usually be detected by the colors it imparts to the fluxes.

"(a) In the oxidizing (bluish) flame, borax beads of molybdenum are yellow when warm and colorless when cold. In the reducing (yellow) flame the warm and cold borax beads are colorless. These beads made in the reducing (yellow) flame when saturated with molybdenum are brown when warm or cold.

"(b) All salt of phosphorus beads of molybdenum are green except the unsaturated, cold bead formed in the oxidizing (bluish) flame, which is colorless.

"(c) If several of the green salt of phosphorus beads are dissolved in dilute hydrochloric (muriatic) acid, and tin is added to the boiling solution, the solution turns brown.

"A sulphide ore must be thoroughly roasted (pulverized and heated on charcoal at a red heat until sulphur fumes are no longer noticeable) before using the mineral in the bead tests. Several tests for molybdenum depend on whether the molybdenum mineral occurs as an oxide or as a sulphide."

News of the Week

The Mining News of ENGINEERING AND MINING JOURNAL-PRESS is obtained exclusively from its own staff and correspondents, both in the United States and in foreign fields. If, under exceptional conditions, material emanating from other sources is published, due acknowledgment and credit will be accorded.

Summary

LARGE mining concessions in Republic of Panama granted English corporation; old mining operations indicate low-grade deposits; public asked to provide £500,000 for prospecting and development.

Phosphate deposits reported in British Columbia; Consolidated Mining & Smelting Co. files application for twenty-four claims.

Leadfield boom boosts Beatty, Nev.; ore low-grade as shown by 2,000 ft. of development.

Mesabi Range begins stockpile ore shipments to Lake for boat transportation early in May.

Twenty mines on Arizona tax roll—New Cornelia explores with diamond drill.

Opposition encountered by proponents of copper tariff —Bureau of Mines preparing "Story of Copper" film— Carriers granted increased freight rate on copper.

Mexico-Orient Railroad to complete line—San Pablo to start mill early in July—Mazapil district, Mexico, active, but hampered by labor laws.

Canadian budget shows slight tax reduction—Red Lake Recording Office moved to Pine Ridge.

Kalgoorlie mines attract attention—Boulder Perseverance and Golden Horseshoe may be reorganized.

Anaconda enlarges surface plant at Belmont mine.

Midwest-Butte shipped 5,399 tons of ore in 1925.

Belgian Zinc Industry Not Up to Pre-War Days

THE Belgian zinc industry has not regained its pre-war activity. Production of crude zinc rose from 162,990 tons in 1924 to 171,890 in 1925. The output of zinc ore is not adequate for the requirements of domestic smelters, and importations from abroad are fairly heavy. Customs figures reveal that the principal foreign sources of supply are Italy, Australia, Spain, and Canada, and importations from Sweden, the United States, and Algeria are also fairly heavy, according to the U. S. Department of Commerce.

Shattuck-Denn Mining Co. Issues Operating Report

The annual report of the Shattuck-Denn Mining Co., Bisbee, Ariz., for the year ended Dec. 31, 1925, has been issued by T. O. McGrath, general manager. The mine was operated continuously during the year, and shipments of lead ore were made direct to the smelter at the rate of 150 tons per day until the first of April, when the mill bins were filled preparatory to resumption of operation of the concentrator, which had been shut down for about four years. Shipments of copper ore to the smelter were slightly less than in 1924. The ore grade was lower, resulting in a higher cost per unit recovered. On an average grade of ore of 5.38 per cent of lead, .088 oz. of gold, and 5.72 oz. of silver per ton, the mill recoveries were 79 per cent of the gold, 60 per cent of the silver, and 91 per cent of the lead.

Panama Gold Concessions

Two Areas Embracing More Than 4,500 Square Miles Granted English Company—Gold Known for Centuries

OFFICIAL details regarding the reported discovery of gold in Panama have just been circulated in London by D. Elliott Alves, chairman of the Panama Corporation, who is known in connection with Venezuelan oil enterprises. Early in 1924 a private syndicate was formed to investigate the rumors regarding Panama's mineral wealth. Acting under the instructions of the syndicate, J. J. Calderwood, who has had South and Central American mining experience, proceeded to Panama and established an assay plant at the El Remance Mines, about 160 miles west from Panama City. Negotiations were undertaken to secure a comprehensive mineral concession within the territory of the republic, and early in 1925 the Panama Government granted a special concession covering the Province of Veraguas, to Mr. Alves. Further negotiations resulted in another concession being granted to him in southern Panama, adjoining Colombia, the total area of the two concessions being about 4,500 square miles. These were the first concessions of this nature ever granted British interests in Panama, and since then a decree has been promulgated by Congress preventing similar concessions being granted again.

The concessions provide that after a period of ten years for exploitation purposes all areas selected by the concessionaires shall continue in their absolute ownership in perpetuity. Neither municipal or national taxes will be levied on the concessions nor on any companies formed under them, but the concessionaires will have to construct roads and bridges where necessary, and to pay a royalty of 2 per cent on any gold exported. The president of the republic is extending every facility to further the success of the enterprise, and the concession includes the full use of timber, water power, stone, and building material.

No Cause for Excitement

Though the gold veins and deposits have been reported as discovered recently, there is no reason to become alarmed over the announcement. The gold veins and deposits have been known to the natives as well as English, French, and Colombian capitalists for many years. In fact, the mines have been worked for centuries in a desultory way, with more or less success, and have been described in a number of publications.[1]

Panama is not entirely a flat, jungle, swamp-land. On the contrary it has a mountain range 500 miles long extending through the central part of the country, with peaks approximating 8,000 ft. in elevation. The dry season in Panama is from December to May. The climate is warm and the tropical vegetation offers many obstacles to

[1]E. R. Woakes: "Dariren Gold Mines," Panama." *Mining Magazine*, London, Nov., 1923. The same author also published in Vol. 29, 1899, *Transactions* of the A.I.M.E., a long article descriptive of this mine. Vol. 3 of the *Transactions* of the Institute of Mining & Metallurgy of London, published in 1895, also contains an account of mining operations in Panama.
Oscar H. Hershey: "Origin of Certain Gold Deposits on the Isthmus of Panama." *American Geologist*, Vol. 24, p. 73, 1899; "Mining in Panama," *Mining & Scientific Press*, Vol. 96, p. 255, 1908.
Scott Turner: "Mining in Panama." *Mining & Scientific Press*, Vol. 96, p. 130, 1908.

mine development. Along the streams are some placer deposits, but these have not as yet proved to be very extensive. There are but few sedimentary rocks, the majority being igneous, consisting of granite and andesite.

Spaniards Discovered Panama Gold 350 Years Ago

Gold was discovered by the Spaniards about 350 years ago, and the mines were later worked by the Colombians, who are accorded the honor of having made a number of fortunes. The Colombians abandoned their properties about 1884, and with no one to take care of them these mines were rapidly covered by trees and vegetation, until at present the country has resumed its primeval state and the mines are not to be seen. In 1910 thirteen mining claims were denounced in the entire Panama country. Of 125 mines and prospects held under valid concession, since 1904, 40 had been abandoned by 1911, and the others have not been worked to any extent.

Nearly all of the known workable gold-bearing quartz veins of the Isthmus of Panama, west of the Panama Railway, are found in two main belts—one on the northern flank of the Cordillera Veraguas, and the other, the El Remance, along the foothills belt on the south side of the mountains near Canazas. Both are long and comparatively narrow, trending in an east-west direction, parallel to the mountain axis.

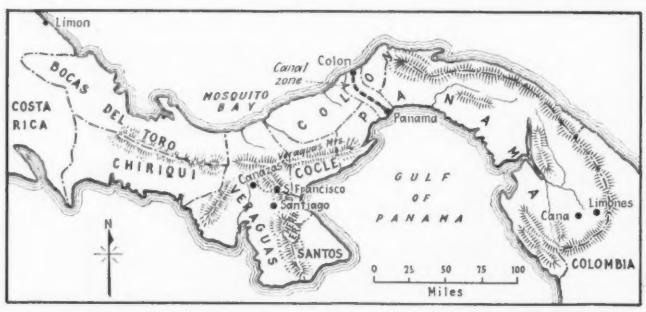
The Cordillera Veraguas are on the line of the old Santa Fe and Cocuya trail, south of west from Panama, and consist of an immense igneous belt probably 25 miles across. The country is very rugged, much dissected, with a crestline 5,000 to 8,000 ft. high.

On the Atlantic side of the divide, in Veraguas, gold-bearing gravel beds have been discovered. Gold placers have been worked on the Bejuco River, in northern Veraguas. Portions of this field at one time yielded gold to the Indians and Spaniards. About eighteen square miles are said to be gold bearing. On the same side of the divide a belt of igneous rock has been located, where three well-defined veins have been discovered at an altitude of 2,000 ft., containing values in silver, zinc, and copper.

The El Remance area is between San Francisco and Canazas on the southern slope and is several miles long and one mile wide. It consists of a gold-bearing zone containing parallel quartz outcrops some eight miles long. Assays show the possibilities of a low-grade development, but exploitation at depth indicates increased values. A representative mine in this field is the El Remance, formerly operated by an English company. It occupies an area of about one-quarter of a mile square. There is one main vein 4 to 15 ft. wide, and in close proximity are a number of smaller veins or stringers, each of which contains gold. The main vein is straight, nearly vertical, and has been mined to a depth of 600 ft. It consists of quartz, with little or no sulphide, and is reported to have a gold content of about $10 per ton.

The center of this mining district is the village of Canazas. About five miles southeast of the village is the La Guaca mine, located in 1833, but not worked until 1887, when an arrastre was installed. The mine was operated for only a few weeks. The vein is reported to be a flat orebody, impregnated in a shattered zone between two andesite walls. No work has been done on this property since about 1894.

Two miles west of Canazas the Detroit-Panama mine was opened many years ago, a company having been organized on the assumption that there was a large deposit of $15 ore. However, when the work of mining began and the mill runs were obtained, the ore averaged only about $2.50 per ton. In this mine the gold occurred in seams in the jointed andesite. The El Gallo mine is said to contain gold ore to the amount of 200,000 tons developed, having an assay value of $2.50 to $4.13 per ton. Many small gold mines were formerly worked along the mountains near the Cocle, Belen, and Indian rivers on the north shore of Colon. The San Antonio mine, in Cocle Province, is said to have produced about $40,000 in gold.



Sketch showing location of gold concessions in Panama

Darien Concession in Long-Known Gold-Bearing Region

The other concession obtained by the Panama Corporation is in southeastern Panama at Cana, where the Darien Gold Mining Co. operated for many years. Whether the concession includes the old Darien and Espirito Santo mines, at Cana, has not been made public.

The Darien and Espirito Santo mines are not far from the Colombian border. They were first worked in 1665 by Dampier. In 1684 Captain Harris, an English buccaneer, took possession for a short time, and operated the mines. In 1702 "four English pirates" at the head of 270 men captured the town of Santa Cruz de Cana, as the mine was then called. In 1727 the mines were abandoned, owing to trouble with the Indians and caved workings. The mines at that time were "four levels deep" and employed about 200 men. In 1877, M. L. N. D. Wyse, engineer in charge of the exploration of Darien for the Panama Canal, visited the mines and claimed them in the name of the canal company. Nothing was done until 1888, when an Anglo-French company, capitalized for £200,000, was formed. Several attempts were made to work the property, a twenty-stamp mill was erected, and some of the ore milled. It proved, however, to be of too low a grade ($1.50 per ton) to be mined profitably, and was closed down in 1892. The old workings were about 200-ft. deep and contained considerable water, and with the poor pumping facilities at hand they were not able to attain any greater depth. In 1893 the mine was again reopened, and continued in a small way for a number of years.

The village of Cana is about fifty miles from El Real, a port on the ocean, and is 2,200-ft. above sea level. The country rock is usually andesite, and wherever gold occurs it is as native gold. In the Darien concession prospecting parties collected evidence of considerable auriferous areas. The beds and banks of rivers and streams showed gold. The district has not been examined in detail, but the engineers regard it as having considerable promise.

To prove and develop the recent rediscoveries, it is necessary to provide working capital. The concessions are therefore to be transferred to a corporation, and the public is asked to subscribe £500,000 to carry on prospecting and development. There remains much work to be done to assure the investor that gold exists in paying quantities. A number of the London financial papers feel that the promoters have not given the public sufficient information to justify the amount asked.

Twenty Mines on Tax Rolls of Arizona

In 1912 there were 82 producing mines on the tax rolls of the State of Arizona. Many of these mines are now worked out and closed. Other mines are unable to operate at the present price of copper and some of them have been closed for five or six years.

In 1918 there were 46 producing mines on the tax rolls of the state. The producing mines in the various counties, have decreased as follows:

	1912	1926
Cochise County	16	7
Gila County	12	5
Greenlee County	7	1
Maricopa County	2	0
Mohave	10	0
Pima County	15	3
Pinal County	6	2
Santa Cruz County	3	0
Yavapai County	9	2
Yuma County	3	0

This reduction in the number of mines does not tell the whole story. Of the mines now operating, four have not paid dividends since 1920. Three have not paid any dividends since 1919. One of the largest companies in the state has paid only two dividends since 1921, and another of the large companies has paid only three dividends of 50c. each per share since 1920.

The Leadfield Boom; Ore Low Grade with but Little Silver

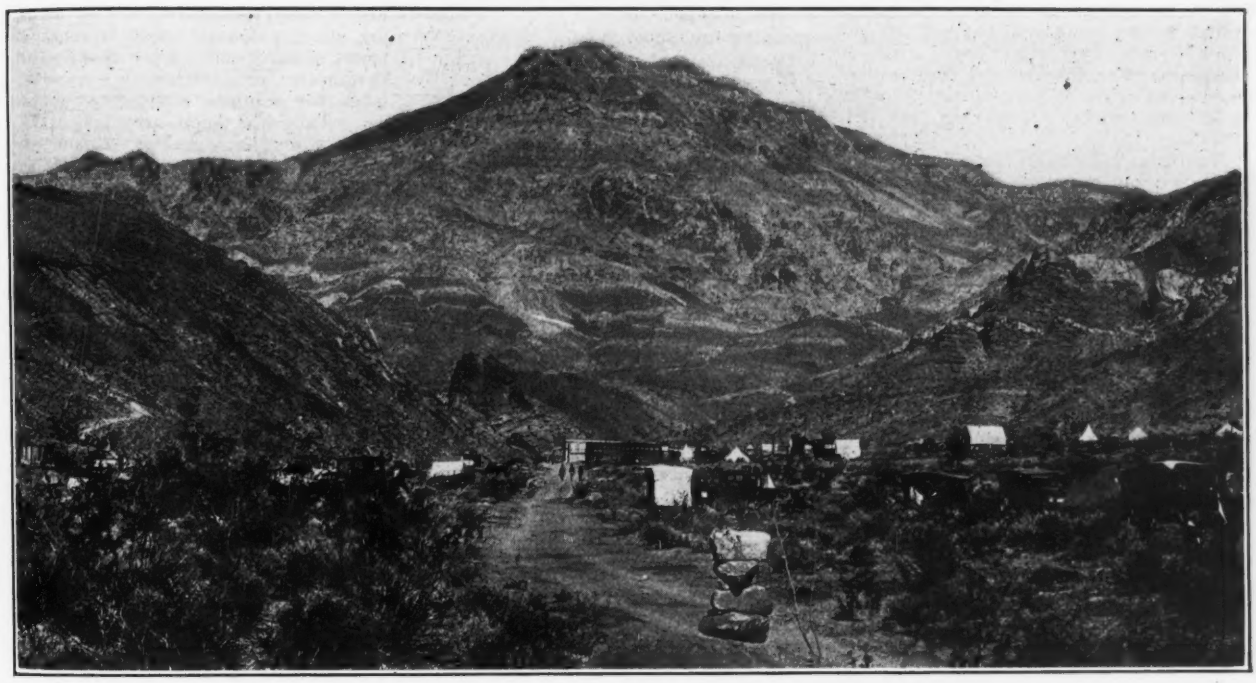
Activity at Leadfield, which is 22 miles westerly from Beatty, Nev., and about two miles across the state line in California, has stimulated business in Beatty and given an impetus to prospecting in the near-by sections of California and Nevada. Beatty is 70 miles southwesterly from Goldfield and 5 miles from the old boom camp of Rhyolite, on the Tonopah and Tidewater railroad. Beatty is the nearest railroad shipping point for Leadfield; hence its relation to the Leadfield boom.

Leadfield used to be 53 miles from Beatty, over difficult road via Death Valley and Titus Canyon, but a new road, recently completed by interested companies at a reported cost of over $50,000, has reduced the distance to 22 miles. The new camp is in the Grape Vine range of mountains, on the east side of Death Valley, at an elevation of from 3,000 to 5,000 ft. The topography is rugged.

The rocks of the district are mostly sedimentary, and comprise limestones, quartzites, and conglomerates, with some volcanics in evidence. The most important known mineralization is in the limestones, at times as fine- and coarse-grained galena associated with light-colored calcite in shattered portions of the limestone, and in other occurrences as very fine-grained galena in a dark-bluish lime. Values are in lead and silver, with some zinc, the relative proportion varying in different parts of the district, and are found scattered over a wide area. Silver content is low and, according to published figures, will average about one-sixth of an ounce for each 1 per cent of lead. This low silver ratio makes a difficult shipping ore, and concentration on the ground appears to be the proper solution, provided sufficient ore is developed to justify the erection of a mill.

The total development work in the Leadfield district will not exceed 2,000 ft., mostly confined to tunnels, with drifts on the best showings. Conflicting reports have been made on the results of work performed to date, with evidence pointing toward the presence of an uncertain tonnage of material containing a low percentage of lead.

Leadfield, as a boom camp, is in the peculiar position of being in a fairly remote district, having good boosters and apparently first-class financial backing. The ore is regarded as too low grade to stand shipment costs, and therefore with nothing tangible upon which the prospective value of the district can be based. In this case we are confronted with optimistic statements, many of which appear to lack the confirmation which can be arrived at only by actual digging.



Leadfield, Calif., Titus Canyon at left of mountain. Western Lead in left foreground

Notes From the Pioche District, Nevada

Shipments continue on a substantial scale from the Pioche district, Nevada, totaling 1,940 tons for the week ended April 20, distributed as follows: Prince Consolidated, 900 tons; Combined Metals mine, 600 tons; Black Metals mine, 200 tons; Bristol Silver mines, 240 tons. Increased shipments from the Prince mine were a feature of the week, the company having begun operations on the upper levels, concentrating work on the 200 level, from which a substantial production was made fifteen years ago, the ores mined carrying 1.50 per cent lead and about 25.0 oz. in silver per ton.

Salt Lake and Los Angeles capital has recently became interested in the Comet district, bonding the Stella mines for $20,000.

The Tungsten-Comet mill is closed down, and will not be reopened until underground development indicates sufficient ore for at least a two years' run.

Commonwealth Mine, Near Reno, Finds Good Ore

It is reported that leasers on the old Commonwealth mine, 15 miles south from Reno, Nev., have recently opened a new high-grade orebody. The Commonwealth mine was worked in the 70's, and is said to have produced a considerable tonnage of lead-silver and zinc ore. The low-grade ore was left untouched, owing partly to its complex nature, but the present prices for lead and zinc, with advantages of the modern improvements in concentration and flotation, make the property appear attractive

The mine is opened by tunnels to a depth of over 300 ft. Its present owners, the Washoe Consolidated Mining Co., of Reno, Nev., are attempting to finance for extensive development work and a milling plant.

New Cornelia Explores With Diamond Drill

The New Cornelia Copper Co. has awarded a contract to the E. J. Longyear Exploration Co., of Minneapolis, to put down a series of diamond-drill holes on the company's property at Ajo, Ariz. New Cornelia has considerable territory outside of the mine pit which has not been tested, and it is expected that the drill work will add an appreciable tonnage to the ore reserves.

News From Washington

By PAUL WOOTON
Special Correspondent

Proposed Duty on Copper Meets Opposition

Increased Freight Rates Allowed on the Metal—Aluminum Import Interests Electrical Industry

Renewed agitation of the copper duty proposal by Senator Cameron, of Arizona, and Representative James, of Michigan, has created the impression that action on such legislation is imminent. Such is not the case. Those favoring this duty realize that they must muster additional support for the plan before they can hope to put it through. For that reason they expect to be active in acquainting the public with arguments which they are advancing.

Inquiries which are reaching Washington show that the interest in this matter is not confined to the United States. At least one foreign government has asked for information on the subject.

It is apparent that the proposition will have to overcome very strong opposition. One point made against it is that the effect will be much the same as that exerted by the Pittman Act on silver production. In the effort to take advantage of the high price, mine capacity was developed which could not be supported normally and the industry is in a worse condition than it would have been had there been no temporary high prices.

It is argued that a tariff on copper would stimulate an industry that already is overdeveloped. It would pave the way for additional assessments to keep mines going that should have been closed years ago. Some of the deep mines, it is argued, well could afford to abandon their present workings and open up their deposits at a new point if there should be need for the copper. The expense of draining and maintaining large old workings, when present operations are confined to small areas, is not justified, some believe.

The point also is made that copper production is not an infant industry and that it needs no nursing. Speaking generally, it has paid big dividends.

The reaction from the electrical industry is that there is more concern over getting the duty off of aluminum than there is over the possibility of a duty on copper. Were a duty imposed on copper substitution of other metals would be hastened, it is declared.

"Story of Copper" to Be a Feature Film by Bureau of Mines

The "Story of Copper" is to be the most pretentious film ever prepared by the U. S. Bureau of Mines. The industry is co-operating in the making of the film. Many of the significant phases of the Kennecott development will be shown. Owing to the distant location of that mine it has been visited by comparatively few persons. These pictures will give a good idea of the way in which that unusual development was carried out and will make a permanent record of workings which eventually will be abandoned.

Increase in Freight Rates on Copper Allowed

Certain increases in the freight rates on ingots of copper, brass, and bronze, and on pig and scrap copper and related articles, have been allowed by the Interstate Commerce Commission. The commission, however, did not approve all of the increases proposed by the carriers. The rates involved are those applying in official classification territory.

The commission finds that a sixth-class basis is reasonable for application on articles taking fifth-class rates, subject to the application of a maximum rate of 40c. between New York and Chicago, scaled on the regular percentage basis at other points in central territory and observing the recognized port differentials. It also finds that 85 per cent of the rates on the fifth-class articles would be reasonable for application on washings, sweepings, skimmings, and other copper residues.

"We see no reason why," says the opinion, "the foregoing bases should not be applied in trunk-line territory and between points in that territory and New England, or central territory where the present rates are now higher, as well as where they are lower than such bases, at least wherever there is a substantial movement. Our findings apply to the sixth-class rates as a whole and are not to be understood as approving the specific rates from and to every point in the above territories. They are subject to any revision that hereafter may be made in such rates."

Shipment of Stockpile Ore Begins at Hibbing, Minn.

The Boeing mine, at Hibbing, Minn., and the Sargeant mine, at Keewatin, started loading from stockpile with steam shovel on April 19. The steamer "Harvester" has left Chicago for Duluth to load Sargeant ore, and it is expected to be the first ore carrier to arrive for the season. Because of the slow disintegration of the harbor ice, loading is not expected to get under headway until May 3.

Phosphate Deposits Reported Near Fernie, B. C.

The Consolidated Mining & Smelting Co. of Canada has made application to the Provincial Government for twenty-four phosphate claims of one square mile each, situated to the west of the Elk River, near Fernie, B. C., and for sixteen claims, situated six miles to the north of the confluence of the Fording and Elk rivers. In the company's annual report, issued at the end of last March, W. M. Archibald, manager of mines for the company, made the following statement:

"Prospecting parties were also active during the season. The outstanding result of this work was the discovery of phosphate beds over a large area in the Province of British Columbia by two young engineers, Leonard Telfer and W. D. Burgess, who were actively employed in the search. These beds are within reasonable distance of the Sullivan mine, and it is anticipated that the discovery will result in bringing the sulphur content of the Sullivan orebody to commercial account and also benefit the agricultural industry."

Transportation to Red Lake Assured

George Wardrope, who was in charge of operations during the winter for the Red Lake Transportation Co., employing seventy teams, three tractors, two motor trucks, and a snow motor, states that active preparations are now being made for summer transportation service. This will open up some time in May, when the company will put eight boats on the route and establish three stopping places. The boats will be gasoline propelled, and the stopping places beyond Hudson will be Pine Ridge, Pagwash Lake, and Red Lake.

Brunswick Mine at Grass Valley to Be Sold

Announcement has been made that the properties of the Brunswick Consolidated Gold Mining Co., of Grass Valley, Calif., are to be sold on June 30, 1926, unless a sale prior to that time is made. Control of the mine has been in the hands of W. H. Oscanyon and T. C. Camp and their associates, and the settlement of the estate of W. H. Oscanyon, who recently died, influenced the majority stockholders in arriving at a decision to sell the property at public auction. Sufficient ore is being mined to supply the 20 stamp mill for one or two shifts per day, but no development plan on any scale has been initiated.

Assets of Bohemia Mining Co. to Be Distributed to Stockholders

The land of the Bohemia Mining Co., consisting of 960 acres in Ontonagon County, Mich., was sold at public auction in the village of Ontonagon April 8 to the Copper Range company. The consideration was $6,500. William A. Paine, president of Copper Range, is also president of the Bohemia company. The lands are chiefly valuable for their mineral possibilities, although it is estimated there is about $3,000 worth of timber on the acreage.

Some diamond drilling was done on the property in 1910. A little copper was found in the cores, but not in sufficient quantity to warrant the sinking of a shaft. The annual meeting of the company was held April 21 at Boston. The affairs of the Bohemia Mining Co. will be wound up and the assets distributed among the stockholders.

The final meeting of the stockholders of the Bohemia Mining Co. will be held May 5 at Boston, Mass. Distribution of the surplus money among the stockholders, according to their respective interests. will be ordered at this time.

Victor Metal Mine No. 2 Damaged by Fire

Fire caused about $50,000 damage at the Victor Metal mine No. 2, the property of the Eagle-Picher Lead Co., in the Joplin-Miami field, on April 21. The mine had been purchased recently by the Eagle-Picher Co., and extensive improvements on the mill were under way. Much valuable new machinery was saved by active efforts on the part of the Picher, Okla., fire company and by the fire brigade of the Eagle-Picher Co. Damage was covered by insurance, and rebuilding will be pushed. The plant would have been ready for operation in about two weeks had it not been for this setback.

Montana Mining Notes

Midwest-Butte Development Co. in 1925 produced 5,399 tons of ore, containing 1,465,283 lb. of zinc, 532,743 lb. of lead, 38,688 oz. of silver, and 64.23 oz. of gold. All of this ore was shipped to the Washoe sampler of the Anaconda Copper Mining Co. Midwest-Butte is developing several claims west of the city of Butte and is hoisting over 30 tons of ore per day.

Liberty Montana Mines Co., operating the Mammoth group of claims, about 18 miles south of Cardwell, Mont., has purchased additional trucks to haul concentrates to the railroad. Last summer an additional Marcy ball mill was placed in the flotation plant.

Butte-East Slope Mining Co. has been incorporated by E. P. Lomas, C. B. Lomas, and M. F. Lyth, of Butte, Mont., to operate a group of five claims east of Columbia Gardens, about eight miles east of Butte. The property is opened with two shafts, 200 ft. apart, both of the shafts being in ore. Plans are being prepared for the erection of a small cyanide plant.

A. N. Weigenstein, of Butte, Mont., has leased from Charles Malloy, of Darby, and J. L. Humble, of Hamilton, thirteen placer claims on Hughes Creek, near Darby, Mont. Frederick L. Minnick, of Seattle, has leased 39 claims, in the same vicinity, from the Montana-Washington Mines, Inc. Both leasers expect to start hydraulicking in the near future.

Raymond E. Tower, John Farrell, and T. E. Peterson, Butte metallurgists, and associates have organized the West Side Milling Co. to erect a flotation plant and treat the mine dumps, consisting of 6,000 tons, at the Elba property, southwest of the city of Butte.

Frank McNulty, Frank N. Leonard, and associates will soon start operations at the "Cripple" property, near Walkerville, north of Butte. Property will be equipped with a compressor and 37-hp. electric hoist, supplied by the Butte Machinery Co.

Anaconda to Have Large Surface Plant at Belmont Mine

That the surface plant required for the new hoisting plant to be erected at the Belmont mine of the Anaconda company will be one of the largest in the country is evidenced by a permit, granted by the Butte (Mont.) City Council, to erect a safety platform across East Mercury St., in the east residence district of Butte. The present hoist is south of the street and the new hoist will be placed north and cables will run across the thoroughfare. A platform will safeguard traffic on the street below.

To make room for the equipment eight additional city lots adjoining present Belmont surface plant were purchased. The permit is for a period of twenty years, with the provision that the company file a statement relieving the city of any responsibility for damage that might occur.

Geological Maps of Rouyn Area, Quebec

Two geological maps of interest to mining men and prospectors have recently been published by the Canadian Geological Survey, Ottawa. They show on a scale of one mile to one inch an area of eight hundred square miles, giving a large part of the Rouyn mining area of northwestern Quebec and surrounding territory. In this map the various rock formations are represented, as usual, by different colors, but some new methods have been adopted which will enable the prospector to estimate closely the amount of rock he may expect to find in any given section of the area.

Mexico Orient Railroad Lines to Bridge Gap in System

More than 2,000 tons of steel rails and trestle material are reported to have been unloaded at the port of Topolobampo, on the west coast of Mexico, for the construction of the Joyanco and Chihuahua gap of the Kansas City, Mexico & Orient Railroad. Headquarters for the road are at Wichita, Kan. The rail extensions will be started soon, it is understood.

San Pablo Mining Co. to Start Mill July 1

The mill at the property of the San Pablo Mining & Milling Co., at Nacozari, Sonora, will be started by the first of July, according to A. C. Burnett, president of the company. The company has received permission from the Arizona Corporation Commission to sell 50,000 shares of its capital stock at 50c. per share. The money is to be used in putting the mill in condition for operation.

The San Pablo company has a three-year lease and bond on the San Pablo mine, near Pilares; a three-year lease on the San Pedro claims of the Moctezuma Copper Co., and a five-year lease on seven other claims near the San Pablo mill. The ground controlled by the company covers 257 acres and contains six veins of gold, silver, lead, copper, and zinc ores.

The San Pedro claims have produced 3,000,000 oz. of silver. A 60-ton mill is in place on the property, but will require about $5,000 to put it in working order. The property has a 330 ft. shaft and more than 12,000 ft. of tunnel and underground workings. Arrangements have been made to secure electric power from the Moctezuma Copper Co.

Notes from Michigan Copper District

Seneca, near Mohawk, Mich., the newest producer in the Lake Superior copper district, is engaged in a program of extensive opening work, with results which lend encouragement to the future of the property. The enlargement of No. 2 Gratiot shaft is under way, and drifting is proceeding in several levels. No. 2 was holed through by the former management to the 24th level, where it connects at a depth of 3,200 ft. with the 3d level north drift from No. 1 shaft.

As an emergency measure, a 125 hp. electric pump will be installed on the 24th level of No. 6 shaft of the Mohawk mine, Mohawk, Mich. Later another unit of similar capacity will be put in place. A 200,000-gal. sump has been built. At present, the water flow at the bottom of the shaft is only 40 gal. per minute. Most of the water is caught at the 13th and 16th levels, where the flow now totals only 165 gal. per minute.

Opening of navigation on the Great Lakes has been delayed by the backward spring. Ice is heavy in some ports. A year ago, navigation was fully under way by the middle of April. The late opening, however, will have little effect so far as copper shipments from the Lake Superior district are concerned, as most of the copper has been shipped by rail.

Production at Calumet & Hecla Consolidated's Ahmeek property, Ahmeek, Mich., is around 3,000,000 lb. of refined copper per month. Allouez rock is now being mined from No. 2 shaft, stoping being under way in the 29th and 30th levels. A faulted area in the 29th apparently has enriched the vein toward the Allouez boundary. No. 2 openings in Ahmeek proper continue in high-grade rock, and the fissure vein is yielding about 120,000 lb. of copper per month.

Joseph Myers, of Bingo Gold, Acquitted

Joseph Myers, managing director of the Bingo Gold Mines, in the Herb Lake area of northern Ontario, charged before Judge Curran, at Winnipeg, with making false statements with an attempt to defraud, was honorably acquitted on April 14, after a trial lasting for more than a week. A large number of witnesses were summoned for the prosecution, but Judge Curran ruled that he would allow no evidence to be given of analyses made from ores taken from the mine unless it could be proved that the samples were taken from the exact spot as those which the crown claimed had been salted.

Jarillas Mine to Be Worked by Los Angeles Men

The Jarillas mine, situated 12 miles northeast of Nogales, Ariz., is reported to have been sold to L. A. Lambert and J. J. Christie, both of Los Angeles. According to George R. Hay, who is said to have consummated the sale, the new owners have excellent financial backing and are fully prepared to undertake the work of further developing the old silver-lead property.

Toronto Letter

By Our Special Correspondent for Northern Ontario

Canadian Budget Shows Slight Reduction in Tax Rates—Red Lake Recording Office Moved

The presentation of the new budget in Canada is always awaited with a great deal of interest, and this was particularly the case this year, as it was generally believed that there would be a reduction in the income tax. Budget secrets are always carefully guarded, but this forecast proved to be correct. Not only were individual income taxes reduced in a way to help the average man, but the corporation tax was also reduced. The old rate was 10 per cent of the net taxable income and 5 per cent of the amount of the tax paid, making a total of 10½ per cent. This has now been reduced to a total of 9 per cent. Mining companies of course are permitted to deduct a substantial allowance for depletion.

The new budget means a saving of about $100,000 a year to the metal-mining industry of Ontario. There was some disappointment over the fact that duties and sales taxes were not reduced on certain articles of mining machinery, some of which are of a class or kind not manufactured in this country. The lumber industry and the farmers get certain considerations in the way of lower duties and exemptions from sales tax on certain machinery used in their operations. Mining companies, however, using the same machinery pay a much higher duty and pay the sales tax as well. No consideration of this kind was given to the mining companies, but the government has appointed an Advisory Tariff Board and prefers to leave all such matters for the board's consideration.

Diamond Drills Testing Ground in Red Lake District

The latest news from Red Lake is to the effect that the five diamond drills on the Dome and McIntyre properties are now working. The first results should be available in about three weeks, as the preliminary drilling will be designed to cut the vein at a vertical depth of about 300 ft. Transportation is getting more difficult with the warmer weather, and a few days ago one of the tractors was lost through the ice at Lac Seul.

At the special meeting of the unit holders of the Howey Red Lake Syndicate held on April 20, arrangements were made to distribute $50,000 which was received as the first cash payment from the Dome. This distribution will amount to $10 a unit, or at the rate of 1,000 per cent on the issued capital. If the deal is carried through to completion, unit holders will receive a total of 10,000 per cent, plus a total 5 per cent interest in the Howey Red Lake Gold Mines.

The Ontario Government has decided to move the Red Lake Recording Office to Pine Ridge. It is felt that the Recording Office at Red Lake has served the purpose for which it was started, and on account of the interest being taken in the Woman Lake and Birch Lake districts, it was felt better to move the office to Pine Ridge, which is the junction point of the waterways for the different districts. It is also believed that the Red Lake mining area will be enlarged to take in the district to the east covering Woman Lake and Birch Lake.

Hudson, Ontario, the beginning of the trail to Red Lake

Notes From Mazapil District, Zacatecas

The Aranzazu and Nazareno mines, in the Mazapil district, Zacatecas, Mexico, are now being unwatered; these mines were flooded by the heavy rains that fell during the winter months. The San Eligio mine of the Mazapil Copper Co. is developing mixed sulphide ore in the 11th and 12th levels. A mill to treat these sulphide ores is almost completed and is expected to be in operation in May. R. H. Jeffrey is general manager.

The Providencia mine of the Peñoles Mining Co. is opening the 11th level in sulphide ore similar to that in the San Eligio mine. Santa Rosa mine is shipping ore direct to the smelter and is also milling a lower-grade ore. Geoffrey Wastenys is succeeded as general superintendent by Mr. Terrazas. Shaft sinking and other development work is being continued in the Rucio mine by the American Smelting & Refining Co., which has this mine under lease. The Refugio mine of the same company is shipping lead-silver ore to the Monterey smelter.

Local authorities at Mazapil are going to the extreme in enforcing recently enacted labor laws in Zacatecas. There appears to be violent objections to any foreign companies operating in this district, so far as local authorities are concerned, although this is not supposed to be the attitude of the state or federal authorities toward employers of labor.

Melbourne Letter

By Peter G. Tait

Special Correspondent

Kalgoorlie Mines Attract Attention; Reorganizations Contemplated

Melbourne March 25—So far there has been no practical result from the exposure by Kingsley Thomas of the conditions obtaining at the Kalgoorlie mines, and it almost looked as though his report was to be pigeonholed. However, it is doubtless because of the conditions broadcast in that report that Dr. K. B. Edwards, a director of the Boulder Perseverance mine, Kalgoorlie, and formerly a director of technical research with William Cooper & Nephews, Ltd., chemical manufacturers, England, is at present in Australia conferring with the local management regarding the future activities of the mine. It is well known that the tribute parties, while working the mine, were able to produce considerable tonnages of high-grade ore and did very well both for themselves and the company. It is generally believed that the mine has sufficient life to warrant reorganization, and it is to make a recommendation in the direction that Dr. Edwards is visiting Australia.

Another Kalgoorlie mine which is attracting considerable attention at the moment is the Golden Horseshoe, of which J. W. Sutherland is manager. This mine adjoins the Great Boulder property on the east, the Ivanhoe on the north, and Chaffers on the south. The Ivanhoe lodes run through the Horseshoe grounds into the Chaffers mine and the Great Boulder main lode dips across the eastern boundary at a depth of about 2,500 ft. from the surface, and is then in the Golden Horseshoe lease at all the lower levels. To the end of 1924 the Golden Horseshoe produced 4,668,967 tons, from which has been recovered 2,950,741 oz. of fine gold. The company has been a most consistent dividend payer, £3.652.500 having been distributed among the shareholders. During the last year or two, owing to the high costs, it has been necessary to increase the average grade of the milling ore by drawing on the reserves of higher-grade material, and in 1925 the returns, 36s. 7.8d., were not sufficient to cover the mine working costs of 40s. 4.8d. Owing to the reduction in the reserves and the increasing costs, the tonnage treated has decreased in ten years from approximately 280,000 tons to 110,000 and the costs have increased from 22s. to 40s. In 1925 the company obtained a bank guarantee from the government to relieve the financial position, and at the end of last year a further guarantee up to £50,000 was obtained, to assist the company with regard to development work. A. Montgomery, State Mining Engineer of Western Australia, furnished the government with a comprehensive report on the property. In this report he states:

"The present position of the mine is hopeless unless there is a great alteration in the policy followed by the company in recent years."

London Letter

By W. A. Doman
Special Correspondent

Panama Gold Prospectus Released—Flotation Criticised by Press

London, April 13—I have kept *Engineering and Mining Journal-Press* pretty well posted with regard to the position of the Panama Corporation; in fact, its readers in America and elsewhere have been better informed than most people on this side of the ocean. The long-expected flotation was made yesterday, and it caused a certain amount of excitement. The moving spirit is Duncan Elliott Alves, well known in connection with the Venezuelan Oil Concessions and the British Controlled Oilfields. He has addressed the press representatives; and he or his associates have given out page advertisements with reference to Panama, and have—so a foreigner informed me—plastered this country and some of the Continental centers with particulars of the discoveries at Panama. These are referred to as a "New Rand," and many people have awaited the issue of the prospectus. Evidently, and contrary to the opinion of the promoters, the prospectus did not have "a good press." Two journals under the same financial control spoke well of the issue—in fact, gave it a good deal of praise; but apart from them and a small weekly publication, the serious journals were severely critical. And, I think, rightly. The leaders—*The Times*, *The Daily Mail*, and *The Financial News*—took exception to the way the issue was made. Naturally, the prospectus is full of matter, but when it comes to inviting subscriptions this matter is not satisfying. The only definite statements are that concessions have been obtained in Panama and that the government is favorable to their working. What the critics do not like is the haste with which the promoters wish to turn their efforts into something tangible. Nothing approaching a mine has been proved, and there is no mention of working costs, or difficulties—and one can see that they are great. In the early stages of mining the British public do not object to taking risks, but in the case of the Panama Corporation, the vendors are acting in a quaint manner—in technical circles "quaint" is not the expression used, but it will do here. The promoters and vendors ask the public to subscribe £500,000 to meet all the obligations of the concessions and to carry on prospecting operations. This means that the public put up all the money and take all the risk, and the promoters and vendors receive £1,000,000 in shares, and although they have disposed of the concessions and got their outlay returned they are entitled to two-thirds of whatever is found by means of the money subscribed by the public!

Another nice little joke is that the total underwriting commission is £25,000 and the underwriters also get an option to subscribe at par for £250,000 of shares of the Corporation up to Dec. 31, 1927, for "undertaking the printing, advertising, and circulating of the prospectus at the expense of the company," the underwriters retaining all the ordinary trade commissions, rebates, and discounts. If the finance of the undertaking had been on a moderate scale, other shortcomings of the prospectus might have been overlooked, or less fiercely criticised. The prospectus, as issued, differs from the original, so that certain people, as I remarked on a previous occasion, have "thought hard."

At the Rio Tinto meeting a few days ago it was officially stated by the chairman, Sir Auckland Geddes, that the company would, at the end of 1928, cease to be members of the Pyrites Producers Association. The board had come to the conclusion that the association, by its efforts to raise prices, has increased competition, which has had the effect of making many consumers of sulphur look to sources of supply other than pyrites. The Tinto does not make profits from sulphur, but sulphur itself carries more valuable products into circulation.

Diamond Exports from Brazil

EXPORTS of miners' diamonds from Bahia, Brazil, according to U. S. Department of Commerce, increased considerably during 1925, and prices rose to unusual levels, owing to the keen competition among resident American buyers. Exports amounted to 13,254 carats in 1924, and increased 52 per cent, to 20,197 carats, in 1925, and the increase in values amounted to almost 100 per cent. Exports of rough diamonds, on the other hand, fell from 1,358 carats in 1924 to 811 in 1925.

No definite action was taken by the state legislature on proposed legislation to enable companies with large capital to operate in the diamond fields. Territory has been leased in the carbon district by an American company, which, it is understood, will start operations with modern machinery in 1926.

Loan of $5,000,000 to Giesche Heirs by Government

To keep German zinc ore on German territory for refining, the federal and Prussian state governments are proposing a loan to the Giesche heirs of $5,000,000 on easy terms to enable them to build their own furnaces on German soil.

The plan of the Harriman concern, which holds an option on the Giesche zinc mines in Germany and Poland, was to transport the ore from the German portion of Upper Silesia into Polish Upper Silesia for smelting and then retransport the product back to Germany.

Fears on the part of the German Government that by this system the ores would remain in Poland, and thereby act as a boomerang on the German markets, led to this plan of finding a solution. This project would also eliminate danger of the Harriman interest having a monopoly on European zinc production and would settle one of the most moot points between the Harriman interests and the Prussian Government.

Johannesburg Letter

By John Watson
Special Correspondent

Antimony in North Transvaal—Tanganyika Diamonds Promising

Johannesburg, March 23—Regarding the reefs of antimony and gold in the Murchison Range, in the Northern Transvaal, a correspondent, writing to *The Star*, says he has been trying for the last three years to get something done. He could have raised the capital in London recently, but had not secured suitable ground. He estimates that about £6,500 would be enough outlay to reduce the stibnite to metallic antimony. The cost of separating the antimony and recovering 90 per cent of the gold would be about 30s. per ton. The gold contents per ton would pay expenses and the antimony would be profit.

H. Walsh, who was engaged erecting the plant for Tanganyika Diamonds, Ltd., until the Anglo-American Corporation took it over, has returned to Johannesburg. He says all the old Kimberley men were much impressed on arrival at M'Wanza, with the extent of the diamondiferous area and the absence of waste overburden. The concentrate is washable, can be treated direct, and appears to be a clean mining operation. The existing plant has a capacity of 600 loads a day.

A new company, South African Minerals, Ltd., has issued its prospectus. It has been formed for the purpose of acquiring mineral rights from Samuel Chudleigh, on six farms in the Rustenburg district, to exploit them for nickel and copper. In places, samples have shown the presence of chromium, silver, gold, platinum, and osmiridium. A report was issued by the company's consulting engineer, Arthur L. Chambers. The capital of the company is proposed to be £300,000 in £1 shares. Shares to the number of 100,000 are now offered for subscription.

Some questions having recently been addressed to the local press re gold and platinoid values at the Komati United Mines, the secretary has replied that all the reports can be seen by any shareholder at the company's office during business hours. Sir William Ramsay's assays showed (on a bulk sample of ore, before treatment): fine gold, 5 oz. 12 dwt. 18 gr.; platinoids, 10 dwt. 6 gr. This result has been confirmed as regards gold by local assayers on samples taken recently, though the platinoid results are somewhat lower. A sample of ore treated by oil flotation did not contain any platinum. Owing to the erratic occurrence of platinoids, the directors are concentrating on the extraction of the high gold values, leaving platinoids for later investigation.

On the Johannesburg Stock Exchange, during the past week, gold shares have in the main been steady and firm. London has been doing more selling and buying here. T. C. Lands were unusually quiet and are about 1s. 6d. lower on the week's balance, closing with sales at 63s. 6d. on Saturday.

Societies, Addresses, and Reports

J. L. Bruce Tells of Conditions at Cyprus Mines

Former Butte Engineer Now Manager of Ancient Copper Properties—Labor Inefficient—Conditions Healthful

James L. Bruce, formerly manager of the Butte & Superior Mining Co. and general manager of the Davis-Daly Copper Co., who last fall accepted the management of the property of the Cyprus Mines Corporation, upon the island of Cyprus, in the Mediterranean Sea, has written to friends in Montana some interesting details of conditions in Cyprus. The following extracts are from the letter printed in the "Butte Miner":

From Famagusta, the port, it is a drive of about 80 miles by auto to Skouriotissa, our home at the mine. Except for the unprepossessing but somewhat interesting villages through which we pass, the ride has not much to make it attractive, as it passes through the middle of a broad flat dried-up valley nearly all devoid of trees.

The fields, which are without fences, are nearly all cultivated in a crude way without implements other than a wooden plow, and the stones are seldom or never picked off. A few miles from Skouriotissa we start to climb the foothills of the island's greatest mountain, Troodos, which rises to an elevation of about 6,500 ft. above the sea in a distance of about 15 miles, and at Skouriotissa we are in one of the prettier of the valleys and in one of the best watered, which, however, is not saying much, as there is no stream on the island that carries water to the sea, except by subterranean channels, the year around. There are no dwellings nor buildings in the fields, as all the people live in the villages and travel with their oxen or donkeys as much as two or three miles each day to work in the fields. Along the roadsides we see many people traveling on foot or with their feet trailing near the ground on the backs of the little donkeys that seem to be man's most faithful friend here.

The invasion of Cyprus by Henry Ford and his agents indicates that Henry is not likely to be worried by the "saturation point" for autos, or at least for Fords, for some time to come. The caravans of camels are still holding their own for cross-country freighting and we see many with from six to twelve of those ungainly and unfriendly looking beasts, carrying everything from petrol (gasoline) tins to fruit and furniture. The drivers drape themselves across the camel's hump and get their sleep on the run.

The Mine

The mine is about 900 ft. above the sea. The orebody is a large and solid mass of nearly pure pyrite carrying about 2.25 per cent copper, 49 per cent sulphur, and 40 per cent iron, located well up toward the cap of a good-sized hill, and containing more than 6,000,000 tons of ore. We are now developing the top-slicing system of mining to replace cut-and-fill stopes which have not been satisfactory in the past. The underground temperature, due to oxidation, runs as high as 150 deg. F. and ventilation is difficult and expensive on account of the heat and the sulphur gases. The ore is mined through tunnels, most of it crushed to ½-in. size, then hauled in 15-ton cars by 25-ton locomotives, over a 30-in. gage track, about six miles to the shore, where it is stored in piles until shipped. When shipping the ore is hauled in five-ton cars over a jetty supported on wood piles, to barges that hold about 150 tons. A steam tug takes these out in the bay about 1,000 ft. to where the larger ships lie at anchor. The ore is shoveled from the barges into buckets that are hoisted by the ship's steam winches and dumped in the hatches. We have loaded as much as 1,800 long tons in twenty-four hours in this manner. The ore goes to European points including Venice, Genoa, Trieste, Marseilles, Hamburg, Harburg, Hull and Middlesex, where it is roasted for its sulphuric acid, the residue being leached for copper, and this residue sometimes smelted for iron.

Wages About a Dollar a Day

Our employees, including those in the mine, shops, railway, crushers, power plant, drilling, marine department and office, number about 1,800, of which 300 or more are on the new construction work, on new jetty and ore-storage terminal, power-plant extension, railway, machine shops, dwelling, office quarters, compressor room, pumping and water storage units and pipe lines, fire lines and protection, ore bins, football field, tennis courts, and so on, and on sanitary provisions. The wages of the natives vary from 1½s. to about 6s., the average being about 4s. or about $1 per day. Except for shoveling and tramming and such simple tasks, their labor is not cheap, as most of the work is done improperly and has to be corrected. Effective supervision would cost as much as having work done by higher priced labor in other places. I honestly think that I could get as much accomplished with one-fourth the crew of Joplin or Butte workmen. That is of course, with the proper equipment.

The natives are picturesque and dirty, as they must needs be through lack of domestic accommodations. Very many—in fact most—families sleep on the earth floor in one room, which often constitutes the entire dwelling. In summer, fall, and spring they sleep out on the ground under the trees without anything in the nature of a mattress and without undressing. I suppose many of them go for weeks without removing their clothes. There are many, of course, who are more prosperous, more provident, and more intelligent, but many of these who are rich are without the simple things that we would consider absolute necessities, and their habits have been fixed for so long that the things that we would provide for their welfare and comfort would be wasted, especially along lines of sanitation.

Our local population is a mixture of peoples of Greek, Turkish, and perhaps Egyptian extraction and of Greek Catholic and Mohammedan religion. Some of them wear clothes similar to ours, but many of them wear loose baggy trousers and all but the very poorest Turkish women veil their faces. Payday and the bazaar of country traders, tradespeople, pastry cooks, and other vendors and the costumes of the youthful swells makes a sight worth seeing.

Celebrated Orange Center

The near-by village or town of Lefka is a celebrated orange-growing center in a small way. This is one of the prettiest spots that I have seen in Cyprus, with well-kept orange groves, date palms, cypress, eucalyptus, and cacti hedges. The orange crop lasts for months and has just been coming on lately. We are getting fine oranges now for three piasters (about 9c.) per dozen. We also get fine potatoes, cabbage, cauliflower, peas, beans, vegetable marrow, olives, figs, dates, and walnuts. Meats—chicken, turkey, and lamb—are relatively expensive but good. Most of the servant cooks are men, and some of them are quite good cooks—better than lots of our servants at home.

We now have about eight Americans and about twenty-five English and Scotch members of the staff, and there are now two American and three English wives and one English hospital nurse here and three children. When Mrs. Bruce and our four children and Mrs. Nicholson and her two children get here, we will have quite a community, and as there are a few more wives and some more children who expect to come, we will probably engage a school teacher and open a schoolroom very soon. We have two good tennis courts and a fairly good football field, where the English style of game is played and everybody is getting to enjoy the life very much. With some music, some tennis, some football, some bridge and plenty of good food and interesting work, there is no cause for monotony.

Winter Like June in Butte

Since shortly after Christmas we have had our winter, which consists of stormy, cold rains something like Butte in the June rainy season, but not quite so chilly. It never freezes here, though it does on Mount Troodos, five or six miles away.

In the neighborhood of the mine there are big slag dumps containing close to a million tons of slag, part of which is believed to have been made by the Phoenicians nearly 2,500 years ago and part by the Romans about 2,000 years ago. In the mine, in the midst of the solid pyrite ore, we find firmly consolidated gangue material that is no

doubt the remains of filled drifts or galleries of the old workings, and we have found one or two pieces of the old timber, the pores of which are filled with copper carbonate, but we have found no old tools.

Columbia Section A.I.M.E. Wants More Attention from Parent

More attention by the American Institute of Mining and Metallurgical Engineers to the industry in the Northwest was advocated at the meeting of the Columbia section in Spokane on April 2. The section also went on record in a protest against restrictions on mining operations on the national forest reserves. It was decided to hold a special meeting of the section in Kellogg, Idaho, on May 21, when students of the school of mines at the University of Idaho and the state college of Washington may attend. Alex Ramstead, of Wallace, will be invited to discuss mine taxation, and points of interest will be visited, including an inspection of the new tram of the Sidney Mining Co. and the Bunker Hill smelter at Kellogg.

A committee was authorized to prepare a resolution asking the Washington authorities to permit officials of the U. S. Bureau of Mines to attend at government expense mining meetings of importance at different points in the United States. This resolution will be forwarded to Secretary Herbert Hoover.

Refractories Institute Meets May 12

The American Refractories Institute will hold its annual meeting at the Bellevue-Stratford Hotel, Philadelphia, Pa., on May 12. The following technical papers will be presented:

"Service Conditions in Open-Hearth Furnaces as Affecting the Life of Refractories," by F. W. Schroeder, assistant chemist, U. S. Bureau of Mines, Pittsburgh, Pa.

"The Refractories Industry in New Jersey," by G. H. Brown, head of the ceramics department, Rutgers University, New Brunswick, N. J.

"Mullite Refractories," by M. L. Freed, research fellow, U. S. Bureau of Standards, Washington, D. C.

"Industrial Research," by Dr. E. R. Weidlein, director, Mellon Institute of Industrial Research, Pittsburgh, Pa.

"The Study and Development of Tests for Firebrick, with Special Reference to Spalling," by S. M. Phelps, fellow, refractories fellowship, Mellon Institute, Pittsburgh, Pa.

"Permeability as a Measure of the Uniformity of Firebrick," by Dr. A. E. R. Westman, research fellow, University of Illinois, Urbana, Ill.

These papers and talks, together with the discussions that will be presented from the floor, should be of interest to both consumers and manufacturers of refractories. Arrangements are also being made to have one or two nationally prominent speakers present and talk on subjects of general interests. At noon a luncheon will be served at the hotel. A business session will be continued in the afternoon. All interested will be welcome.

Colby Sees Little Chance of Change in "Extralateral" Statute

Discusses Beginnings of Mining Law for the San Francisco Section of the A.I.M.E.—Prospectors, Not Lawyers, Established Apex Principle

By George J. Young
Associate Editor

AT THE April 13, 1926, meeting of the San Francisco section of the American Institute of Mining and Metallurgical Engineers, William E. Colby, mining lawyer, discussed the begining of mining law. Mr. Colby was at one time associated with Judge Curtis H. Lindley (now deceased), author of "Lindley on Mines," a standard work on mining law. While in Lindley's office, Colby became interested in the preparation of a treatise on the history of mining law. He speedily found out that suitable material was extremely scarce and realizing that, if he was to understand the origin of mining laws, he would have to investigate foreign literature, he began to collect antiquarian material by getting in touch with foreign dealers in different countries. Assisted by friends, among whom was Herbert Hoover, he pursued his quest until after a lapse of some years he has accumulated the most complete collection of books on the subject in America. This collection is now in the library of the University of California.

Turning to his subject after interestingly discussing his hunt for books, Mr. Colby said that mining law in ancient days had no practical existence, as mining ventures were conducted by the sovereign powers and there was no individual competition for mineral rights. As the growth toward more democratic government ensued, the need for laws became apparent, and Athens furnished one of the first examples in the instance of the Laurium silver mines. Mining leases were granted, and some of Demosthenes' orations were on the subject of mining controversies. In the Roman period the concession system was in vogue, but nevertheless it is said that such mining rights as developed were the beginnings of mining law.

In an endeavor to increase their revenues, the ancient overlords sought to encourage the miners by granting them special rights and concessions covering the use of timber and water. In Germany, where mining developed faster than in other countries, a miners' court was formed, and this feature became common in other countries; but despite its obvious advantages and its establishment in England, Italy, and European countries generally, it was never adopted in America. The free right of the miner to stake out his claim and develop it was a significant advance in mining rights that was recognized very early in the history of mining.

In the early days of America there were very few mines, and these were principally developed under a concession system by those who controlled capital and political power. Upon the discovery of gold in California, our present system of mining law was started. Mexico and Spain did not have much occasion to extend their mining laws to the new territory. The New Almaden quicksilver mine was the only mine in operation. As a consequence, when the early miners began their operations there was neither local nor federal law. When congestion manifested itself and it became necessary to determine as between man to man what rights each should have, local laws were formed. The early laws of the 50's made provision for discovery, the posting of claim notices, the staking of claims, and the recording of notices. Provision was also made for annual assessment labor to the amount of $100 per claim. In Colorado the miners established the rights of tunnel claims. Intersections of veins were subject to special provisions, but the most important principle established was the extralateral right.

Mr. Colby stated that although the extralateral right has been credited to the lawyers, it was actually the idea of the miners themselves. In the earliest lode mining in the 50's at Gold Mountain, claims were 30 by 40 ft. with vertical boundaries, and this was continued in other parts of the Grass Valley area. The first instance of extralateral right was in the case of the Saunders' ledge, recorded June 6, 1851; each claim was 100 ft. in length on the ledge, with its dips, spurs and angles. At Dry and Sutter creeks, in the Mother Lode region, on June 7, 1851, the miners likewise adopted a claim length without regard to width, the length of claim being 240 ft. along the ledge. At Angels' Camp, the Morgan mine, located in February, 1851, and one of the earliest claims, the extralateral right was taken. It thus became established as a fundamental principle in mining law.

Mr. Colby expressed the opinion that it is now too late to change the extralateral right fundamentally. To abolish the extralateral right would necessarily entail the abolishment of the discovery provision. He also stated that no effort was made to separate mineral rights from surface rights except in recent years in the case of oil and coal.

South African Meeting

The monthly meeting of the South African Institution of Engineers was held in Johannesburg on March 10, A. L. Egan gave his reply to the discussion of his paper on "The Design of Tips for Skips for Vertical Shafts." A new paper was read on "Coal Treatment by Low Temperature Carbonization in Connection With the Generation of Electric Power," by C. W. Tozer, of Ballengeich, Natal.

Recent Technical Publications

Reviews, Abstracts, and References

Graphic Analysis

Graphic Charts in Business—By Allan C. Haskell. Published by the Codex Book Co., New York City. Price $4.

A complete mine survey may be recorded by means of a set of figures giving bearings and distances. Several pages of such data, however, can be shown on a comparatively simple map; and such a map conveys to the engineer a conception of the workings in question with incalculably less effort on his part then could the figures themselves. In the same way a few columns of figures can represent a group of technical or economic facts or conditions fluctuating during a period of days, months, or years. A man particularly familiar with the subject concerned probably could, with sufficient close study, obtain a fairly accurate mental picture of what the figures show. On the other hand, it is possible to plot the data graphically on cross-section paper so that any intelligent observer can grasp the significant facts almost instantly. This does not mean that he can analyze the data and answer the many questions that are likely to be raised; but he can see relations that would be exceedingly obscure in a tabulation of numerical figures.

Progress in the art of presenting statistics graphically has been remarkable since the war. It seems strange that the obvious merits of the system were not taken advantage of more fully years ago; but statisticians declare that more has been accomplished in this direction in the last five years than in the whole span of preceding time. Striking proof of this may be found in comparing the pages of business and industrial periodicals of the present day with those of a few years ago, and in the special courses in statistics being offered by the leading universities and colleges.

One merit of this volume by Mr. Haskell is that it is highly practical. Some of the books on the graphical presentation of statistics fairly bristle with mathematics—"higher" as well as not so high. The present work does not go into intricate mathematical phases of the problem; nor is it necessary. The author aims to show the average business man or executive how and when he can save time, effort, and money, by using graphic charts. A valuable section is that in which he explains the purposes for which paper with "ratio" instead of "plain" ruling should be used. The distinction is that in the latter the vertical scale is divided arithmetically, whereas in the former the divisions are logarithmic—that is they are the same as the divisions on a slide rule. This characteristic permits a direct comparison of *rates* of variation irrespective of the comparative magnitude of two variables.

Most charts hitherto have been made on "plain" paper, oftentimes when the object in view could much better be attained by the use of "ratio" paper. On the other hand, for certain purposes plain paper should be used. The reason for the choice is made clear by Mr. Haskell; it is a matter of more vital importance than is usually realized.

Scores of examples illustrated by actual charts appear in the book, with practical advice as to the methods of construction that will produce the most useful results. Though of course not designed particularly for the use of the mine manager or superintendent, the material in the book is quite applicable to the problems of mine, mill, or smelter operation or of marketing products. There is no question that intelligent administrators are making use of graphic methods to an ever increasing extent. Great opportunity is presented to improve efficiency and to increase profits as a direct consequence of keeping a finger on the pulse of each department by utilizing suitable graphic records. A. B. PARSONS.

Canadian Institute — The February *Bulletin* of the Canadian Institute of Mining and Metallurgy (603 Drummond Building, Montreal; price $1) contains the following papers: "The Nickel Industry," by Paul D. Merica, 40 pages; "A Visit to the Gem Districts of Ceylon and Burma," by Frank D. Adams, 35 pages; "The Marketing of Ores," by Geo. A. Guess, 10 pages; "Red Lake Area of Patricia," by E. L. Bruce, 16 pages; "Gold Mining in Nova Scotia," by J. C. Murray, 17 pages; and "Canadian Mineral Resources, Limited," by C. M. Campbell, 22 pages.

The March issue contains the following: "Have You a Research Problem?" by F. E. Lathe, 19 pages; "Research Co-operation Between University and Industry," by R. S. McCaffrey, 7 pages; "A Stock-taking of the Profession, with Special Reference to Exploration," by W. L. Goodwin and W. M. Goodwin, 10 pages; "A Lead and Zinc Deposit in Keewatin Iron Formation," by E. S. Moore, 8 pages; "Resorption as an Agent in Freeing Hematite from Grenville Granite Magma," by G. W. Bain, 14 pages; and "The Goudreau Gold Area," by George W. MacLeod and Geo. S. Cowie, 9 pages.

Geochemistry—Parts 2, 3, 4 and 5 of "Geochemische Verteilungsgesetze der Elements" have been published by Jacob Dybwad, Oslo, Norway. The titles and authors of the various sections are as follows: Part 2, "Beziehungen zwischen den Geochemischen Verteilungsgesetzen und dem Bau der Atome," by V. M. Goldschmidt; Part 3, "Rontgenspektrographische Untersuchungen uber die Verteilung der seltenen Erdmetalle in Mineralen," by V. M. Goldschmidt and L. Thomassen; Part 4. "Zur Krystallstruktur der Oxyde der Seltenen Erdmetalle," by V. M. Goldschmidt, F. Ulrich, and T. Barth; and Part 5, "Isomorphie und Polymorphie der Sesquioxyde. Die Lanthaniden-Kontraktion und ihre Konsequenzen," by V. M. Goldschmidt, T. Barth, and G. Lunde.

Patents

Screen—No. 1,577,310. March 16, 1926. H. M. Sutton, W. L. and E. G. Steele, Dallas, Texas. A reciprocating apparatus and base for a shaking screen.

Carnotite Treatment — No. 1,577,411. March 16, 1926. K. B. Thews, Denver, assignor to W. A. J. Bell, Denver. Carnotite ore, in the presence of a reducing agent, is subjected to external heat for roasting and then treated with an acid solvent to extract the vanadium, uranium, and radium.

Electrolytic Refining—No. 1,577,898. March 23, 1926. August Dassbach, Hanan-on-the-Main, Germany, assignor to Irvington Smelting & Refining Works, Irvington, N. J. An arrangement for supporting anodes and cathodes in dissolving vats, and for scrapers interposed between the electrodes.

Cyanide Process — No. 1,578,618, March 30, 1926. H. V. Welch, Los Angeles, assignor to International Precipitation Co., Los Angeles. Gold, silver, and copper are extracted from ores by cyanide solution, and are then precipitated by an agent that will also regenerate a soluble cyanide in the solution for cyclic use thereof. The cyanide content of the solution is adjusted so that the solution, during the precipitation of the copper, contains in excess of four mols of cyanide, calculated as sodium cyanide, for each mol of copper present in the solution.

Thickener—No. 1,578,625. March 30, 1926. C. W. Ankeny, Colorado Springs, Colo., assignor to The Dorr Co., New York City. Design for a tray thickener.

Furnace Wall—No. 1,579,340. April 6, 1926. Filip Tharaldsen, Oslo, Norway. Design of a furnace wall on the inside of which powdered material is banked for smelting, with baffles to prevent its spreading out into the furnace. An opening in the wall is provided through which tools may be introduced.

Hydrometallurgy — No. 1,579,355. April 6, 1926. W. E. Greenawalt, Denver. A rotary arrangement for treating a liquid with a gas.

No. 1,579,356. April 6, 1926. W. E. Greenawalt, Denver. Copper ores are agitated with an acid solution to extract a portion of the copper, the solution then being separated from the residue, and the sand and slime of the ore also being separated from each other. The copper is precipitated and the barren solution remaining, used for treating the sand by percolation.

Fume Precipitation—No. 1,579,462. April 6, 1926. H. A. Wintermute, New York City, assignor to Research Corporation, New York City. Dust is precipitated from a gas stream by electrical methods, the gas passing at such velocity that the deposited particles are detached in agglomerated form and carried on by the stream.

Flotation—No. 1,579,722. April 6, 1926. B. M. McAtee, Miami, Ariz., assignor to General Engineering Co., Salt Lake City, Utah. A pneumatic flotation cell of comparatively great width and length but with a very shallow body of pulp. Circulation of the pulp is at a velocity sufficient to prevent blanketing of the porous bottom.

People You Should Know About

Courtenay De Kalb has just been at Ducktown, Tenn., and will shortly be in New York City.

Norman Carmichael, a director of Phelps Dodge Corporation, has been visiting the Clifton-Morenci district.

Charles A. Mitke has been making a professional visit to the United Verde Extension Mining Co. in Jerome, Ariz.

Francis R. Pyne has accepted the position of superintendent of the Raritan Copper Works, Perth Amboy, N. J.

Clifford Wilfley is making an examination of the Paris-Excelsior mine at Alma, Colo., for Kirby Thomas, of New York.

C. W. Plum, formerly assistant superintendent of the Mammoth mine, at Kennett, Calif., is now in charge of mining operations at Mason Valley, Nev.

Murray Kennedy, who was for some time manager of the Castle-Trethewey Mines, in Gowganda, has been appointed manager of the Gowganda Bullion Mines.

R. S. Botsford, mining engineer, has just arrived in New York from Paris, and will leave soon for the Zancudo mine, in Colombia, of which he has been appointed a director.

H. G. Ferguson, of the Geologic Branch of the U. S. Geological Survey, sailed on April 24 for Spain, to attend the meetings of the International Geological Congress in Madrid.

B. C. Holmes was recently elected president of the Texas Company. He succeeds **Amos L. Beaty,** who was made chairman of the board of directors to replace **E. C. Lufkin,** resigned.

Howard Poillon, of New York, consulting engineer for the Mason Valley Mines Co., recently made an inspection of operations at the Mason Valley (Nevada) mine of his company.

Gerald R. Simpson, of the Simpson Engineering Co., of Long Beach, Calif., has spent the last several weeks in Barstow, Calif., supervising the starting up of the concentrating plant of the Lead Mountain Mines.

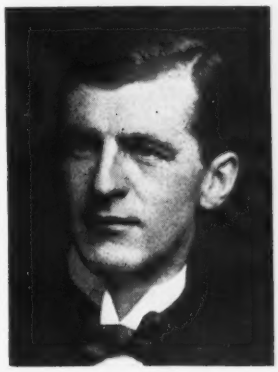
P. W. Racey has been appointed superintendent of the Tonopah Belmont Development Co. mine at Tonopah, Nev., **L. R. Robins** having moved to Wickenburg, Ariz., to take charge of his company's operations there.

J. H. Curle, author of "The Gold Mines of the World," who was a pioneer of Johannesburg, went to Capetown, South Africa, recently, from England. He arrived in Johannesburg, on March 6, on one of his periodical visits.

T. A. Jagger, of the Geologic Branch of the U. S. Geological Survey, who has been in the Hawaiian Islands, had planned to make a trip to Washington; but his visit has been postponed on account of the activity of Mauna Loa.

H. A. Buehler, State Geologist of Missouri; **C. E. Siebenthal,** of the U. S. Bureau of Mines; and **J. E. Spurr** were this week entertained by the operators in the Tri-State district, especial opportunties being afforded them for a study of geologic formations in that region.

C. E. Siebenthal, of the Geologic Branch of the U. S. Geological Survey, left Washington on April 17 for St. Louis to attend the meeting of the American Zinc Institute April 19 and 20. He will later spend a few days in the Tri-State district.



Dr. J. M. Bell

Dr. J. Mackintosh Bell, managing director of Huronian Belt Mining Co., has returned from a visit to England, and reports that financial circles there are showing increased interest in Canadian mining enterprises. He is now making an inspection of the various properties in northern Ontario in which he is interested.

Philip S. Smith, of the Alaska Branch of the U. S. Geological Survey, reports that his supplies have been freighted past Kivalina and were safely landed at Kokolik on April 10. His party is working toward Kokolik, which they will reach about May 1.

C. B. Kingston, late consulting engineer to the African and European Investment Corporation, (Lewis & Marks), left Johannesburg on March 20 to join his family in Capetown. He sailed with them, on the "Euripides," on Mach 25 on a six months' holiday in England.

Giovanni Bruscantini, consulting mining engineer of Santiago de Cuba, has been appointed by the Italian Government as the Italian delegate to the joint commission for the appraisal of the damage claims which the Italian residents in Haiti have presented to the Haitian Government.

J. E. Spurr attended the meeting of the American Zinc Institute in St. Louis last week. Following the close of the meeting he spent a few days in the fluorspar district of southern Illinois, thence going to Rolla, Mo. During the current week he is visiting the Tri-State lead district of Missouri, Kansas, and Oklahoma. He is expected in New York on May 3.

Miss Alice D. Wilson, a well-known geologist, who is following her profession under the Canadian Government at Ottawa, has been awarded the $1,000 scholarship donated annually by the Canadian Federation of University Women's Clubs. Miss Wilson was the first woman ever sent out on field work by the Canadian Survey. A few years ago she explored an extensive territory on the west coast of Lake Manitoba.

E. C. J. Meyer was recently appointed general manager of New Modderfontein Gold Mine, in succession to **E. Miles Sharp.** Mr. Meyer is South African born, having been born and educated in Kimberley, going later to the South African College at Capetown. He qualified as a government land surveyor in 1904 and for two years was in the employ of Lewis & Marks. His practical mining experience was gained on the East Rand, where in 1917 he became general manager of the E. R. P. M.

Obituary

J. M. Garvin, president of the Rock Run Iron & Furnace Co. of Rock Run, Ala., died recently at Rome, Ga. Mr. Garvin was a native of Dutchess County, N. Y.

William S. Driver, oil and mining engineer, died recently in New York after a long illness. He was born in Corinth, Miss., in 1860. His wife and four children—W. J. Driver, Howard Driver, Mrs. Alfred Bohn, of New York, and Mrs. W. T. Anderson, of Pelham—survive.

August Thyssen, an outstanding figure in Germany's industrial world during the last decade, died recently at Mulheim. He was eighty-five years old. Born on May 28, 1840, Thyssen was brought up in the neediest circumstances. At the age of twenty he opened a hardware store at Duisburg with limited capital, but eleven years later was able to move his business to Mulheim, in the Ruhr, where he founded the firm of Thyssen & Co. It had a capital of only $6,000. By the time the world war began Thyssen was producing 1,000,800 tons of steel annually and employing 50,000 men. As a result of the conflict he lost his great plants in Lorraine and the harbor at Cen, Normandy, but retained his fortune, estimated at $100,000,000.

J. A. P. Gibb, formerly consulting engineer to the Anglo-French Exploration Co., Ltd., in Johannesburg, died recently in Toronto, Canada. Two years ago, he was transferred to Canada, residing in Toronto. Born in 1879 at Portobello, Scotland, he was educated in Edinburgh, studied mining, and reported on oil properties in the Argentine. In 1904 he came to South Africa and in 1914 succeeded E. J. Way, as consulting engineer to the Anglo-French. Mr. Gibb served with the Royal Engineers, in Flanders, in the Great War and was severely wounded, and from the effects of this experience he never completely recovered. A vote of condolence to his widow was passed, in silence, at the Chemical & Metallurgical meeting in Johannesburg on March 20. Mr. Gibb was a member of the I.M.M.

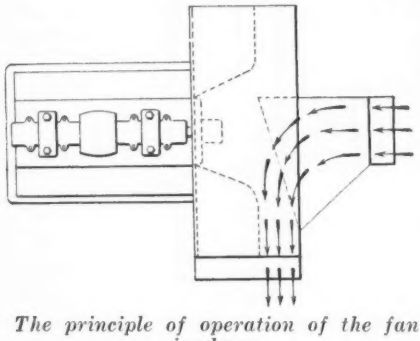
New Machinery and Inventions

Exhaust Fans for Conveying Fine Material

The Connecticut Blower Corporation of Hartford, Conn., has placed on the market an improved type of exhaust fan for conveying finely divided materials by means of air. The principal features of the design are shown in the illustration.

Instead of the inlet being placed at the center of the wheel, it is placed near the periphery of the rotor and adjacent to the outlet. A flare in the inlet pipe toward the discharge opening is also provided. The result is that the material conveyed by the air is discharged immediately without being passed through the wheel and around the casing. The purpose of this arrangement is to reduce the wear of the wheel and the housing and the clogging or unbalancing of the blades.

Each wheel contains sixteen blades that are riveted to a steel cone and a heavy hub. The air set in motion by the rotor rushes past the projected suction opening and creates a suction therein and simultaneously pushes the material-laden air toward the outlet. The combined effect is sufficient to produce a pressure of 12 in. of water in the discharge pipe.

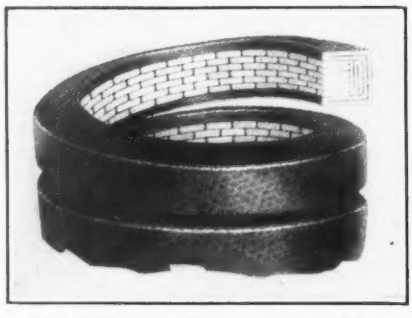


The principle of operation of the fan is shown

The fans are constructed almost entirely of steel. The belt-driven models are equipped with double-row, self-aligning ball bearings. Direct-connected motor types may also be obtained. The fans are made in eleven sizes, either single or double, with inlet diameters ranging from 9 to 33 in. The smallest single-rotor fan weighs 220 lb.; the largest double-rotor fan weighs 2,200 lb. The fans are reversible and the inlet and discharge connections may be arranged in various positions. They may be mounted on the floor or bolted to the ceiling. They will handle any material that can be conveyed by air.

New Metal-Filled Packing

A type of metal-filled packing designed for use on piston and valve rods and other services where high steam pressures are encountered has been brought out recently by the Garlock Packing Co. of Palmyra, N. Y. It has a wearing surface of soft metal inclosed on three sides by a covering of asbestos and rubber. The metal filler in the channel of the packing is of special design and is perforated and cut to fit the various sizes of rod. The design of the filler is such that it tends to hold a large percentage of lubricant and to make the sections or studs seal one another against the pressure.



Metal-filled high-pressure packing

A New Welding Torch

To meet the demand for a small welding torch, the Alexander Milburn Co. has developed a torch that is 18 in. long and weighs 25 oz. It is known as the type J-Jr. In design it is sturdy and compact. It uses the same tips as are supplied with the standard torches of larger size and is said to be adaptable to all classes of welding. It can use gas supplied either from generators or compressed in tanks. It uses low and comparatively equal pressures of oxygen and acetylene.

Lubricating Motors by Means of Grease Tubes

An improvement in motor lubrication has been introduced recently by Fairbanks, Morse & Co., of Chicago. This company now furnishes the proper greases in collapsible tubes, each containing just enough grease for a motor's annual requirements. Instructions are given to flush out the old grease with kerosene and squeeze the new grease directly from the tube into the bearing. Printed instructions supplied with the tube show how much grease should be put into each bearing for best results. Four sizes of tubes are available for the corresponding sizes of bearings. Fairbanks, Morse & Co. were the pioneers, they claim, in developing the ball-bearing motor.

"The Ground-Hog" Makes Its Appearance

The first issue of *The Ground Hog*, a new monthly magazine for shovel men, has just been received. It is published by the Marion Steam Shovel Co., Marion, Ohio. This issue contains two articles, one entitled "Horsepower," telling how the term came to be used as a unit of power, and another describing the gasoline-electric type of power shovel. Two pages of short items containing practical hints for shovel operators will be found interesting.

Trade Catalogs

Hoar Shovels—Bulletin No. 1824 of the Allis-Chalmers Manufacturing Co. is devoted to a description of Hoar shovels, Models No. 2 and No. S-2. This will interest many, inasmuch as no announcement has hitherto been made that this well-known make of mucking machine had been taken over by the Allis-Chalmers company.

Controlling Apparatus—Several bulletins on electric controlling apparatus have been issued by the Allen-Bradley Co., of Milwaukee, Wis. These are punched for filing and are indexed to facilitate reference. They cover d.-c. manual starters, d.-c. automatic starters, d.-c. and a.-c. mill and crane controllers, d.-c. and a.-c. rheostats, a.-c. automatic and manual starters, battery charging and testing equipment, and accessories.

Pumps—The selection and application of centrifugal pumps to mine pumping is the subject of a 20-page leaflet distributed by the De Laval Steam Turbine Co. of Trenton, N. J. Instructions are given for the design of piping and the calculation of friction head power required.

Pumps — Multistage centrifugal pumps of its Class OMS type are covered by the Pennsylvania Pump & Compressor Co. in its Bulletin 207 just issued.

Rolls — Bulletin 130 of the C. G. Buchanan Co., New York City, describes the Type C Buchanan crushing rolls.

Pipes and Tubes—National Tube Co., Pittsburgh, Pa., announces that a new educational motion picture entitled "The Arteries of Industry" has been made. This film depicts the manufacture of wrought pipe. It will be supplied without charge for educational purposes.

Motors—Three bulletins, punched for filing, covering G-E squirrel-cage motors of the 500 series; wound rotor induction motors of types MT and MQ "900" series; and G-E general purpose synchronous motors of the "7,500 Series," have been issued by the General Electric Co., Schenectady, New York.

Vacuum Recorder—The Uehling Instrument Co. 473 Getty Ave., Paterson, N. J., is distributing a new catalog No. 150, covering the company's combined barometer and vacuum recorder for use with steam turbines.

Redwood Tanks—A new catalog, No. 21, issued by the Redwood Manufacturers Co. of San Francisco, describes the construction and dimensions of redwood tanks and accessories.

Redwood Pipe — Catalog No. 11, issued by the Redwood Manufacturers Co. of San Francisco, describes the use and installation of continuous-stave, machine banded, and bored redwood pipes. Continuous-stave flume is also described, pipe-line specifications are given, and accessories detailed. Hydraulic information is included.

Waterproofing—A two-page circular has been issued by the Asphalt Products Co., Inc., Syracuse, N. Y., covering "123 Hydro Proof," an agent for waterproofing concrete.

The Market Report

Dull Week in Metal Markets

Copper and Zinc Easier—Firmer Tone to Lead—Better Prices for Silver and Quicksilver

New York, April 28, 1926—The uncertainty attending the settlement of the British coal-mine labor difficulties has been a strong factor in the metal markets, not only abroad but in this country. Buyers here are disinclined to commit themselves until they see what happens in London. If a satisfactory adjustment is reached, good buying both abroad and in the domestic market is confidently expected. Business in lead has been in larger volume than in the other metals, copper buying has been limited, and zinc and tin have been decidedly dull. A net gain of ¾c. for silver and of $1.25 per flask for quicksilver is shown for the week ending today.

Daily Prices of Metals

April	Copper N. Y. net refinery*	Tin		Lead		Zinc
	Electrolytic	99 Per Cent	Straits	N. Y.	St. L.	St. L.
22	13.60@13.875	61.50	63.00	7.85	7.60@7.65	6.85@6.95
23	13.625@13.75	61.50	63.125	7.85	7.65	6.90@6.95
24	13.625@13.75	61.50	63.25	7.85	7.65	6.90
26	13.70@13.875	62.00	64.00	7.85	7.65	6.925
27	13.70@13.875	61.50	63.75	7.85@7.90	7.65@7.75	6.85@6.90
28	13.675	60.25	63.00	7.85	7.65	6.80@6.85
Av.	13.727	61.375	63.354	7.854	7.654	6.892

The prices correspond to the following quotations for copper delivered: April 22d, 13.85c.@14.125c.; 23d and 24th, 13.875c.@14c.; 26th and 27th, 13.95c.@14.125c.; 28th, 13.925c.

The above quotations are our appraisal of the average of the major markets based generally on sales as made and reported by producers and agencies, and represent to the best of our judgment the prevailing values of the metals for deliveries constituting the major markets, reduced to the basis of New York cash, except where St. Louis is the normal basing point, or as otherwise noted. All prices are in cents per pound. Copper is commonly sold "delivered," which means that the seller pays the freight from the refinery to the buyer's destination.

Quotations for copper are for ordinary forms of wire bars, ingot bars and cakes. For ingots an extra of 0.05c. per lb. is charged and there are other extras for other shapes. Cathodes are sold at a discount of 0.125c. per lb.

Quotations for zinc are for ordinary Prime Western brands. Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

London

April	Copper			Tin		Lead		Zinc	
	Standard		Electrolytic						
	Spot	3M		Spot	3M	Spot	3M	Spot	3M
22	57	57 7/8	64 1/2	281	270	28 1/4	28 3/4	32 3/16	32 1/2
23	57	57 3/4	64 1/2	279 1/4	269 1/2	28 7/16	28 15/16	32 3/16	32 1/2
26	57 1/2	58 3/8	65	280 1/4	270 3/4	28 13/16	29 1/4	32 7/16	32 11/16
27	57 1/4	58 1/8	65	279	269 3/4	28 5/8	29 1/8	32 9/16	32 13/16
28	57 1/8	57 7/8	64 3/4	274 1/4	268 1/4	28 1/4	28 15/16	32 1/2	32 11/16

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

Silver, Gold, and Sterling Exchange

April	Sterling Exchange "Checks"	Silver		Gold London	April	Sterling Exchange "Checks"	Silver		Gold London
		New York	London				New York	London	
22	4.85 5/8	63	29 3/16	84s11½d	26	4.85 3/4	64 1/4	29 3/4	84s11½d
23	4.85 11/16	63 5/8	29 7/16	84s11½d	27	4.85 3/4	63 7/8	29½	84s11d
24	4.85 7/8	64	29 5/8	.....	28	4.85 3/4	64	29 9/16	84s11½d

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London silver quotations are in pence per troy ounce of sterling silver, 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command three-eighths cent premium.

Copper Back at 13⅞c. Delivered

Had it not been for several million pounds of copper sold for Middle West delivery, the volume of business for the week would have been extremely small. These sales, stimulated by the announcement on the part of the Interstate Commerce Commission that the railroads would be permitted to increase rates from New York to Chicago by 8c. per 100 lb., and to other Mid-West points by a proportionate amount, brought the total to the comparatively low level of last week. These rates it is expected will go into effect about June 15. The prevailing price for distant delivery was 14⅛c., with 14¼c. realized on some lots. Small sales were made in the East at 14c., but most of the business done was at concessions of from 5 points to 12½ points. Last Thursday 13.875c. was shaded on several large lots, and today the only business reported has been at 13.875c. at normal freight rate points, with one small sale in the West at 14⅛c. For export 14.15c., c.i.f. and 13.90c. f.a.s. for May-June shipment have been done.

Lead Slightly Stronger

Though lead has fluctuated up and then down in London during the last week, no change has been made in the contract price of the American Smelting & Refining Co., which continues at 7.85c., New York. Today's London prices are slightly higher than a week ago, and the domestic market is distinctly stronger. No shading of the 7.85c., New York, price has been reported, as occurred last week. On the other hand, a small tonnage has sold at 7.90c. for May shipment. In the Middle West, prices were raised to 7.65c. last Thursday, at which level they have been maintained since by practically all sellers, though yesterday lead sold in Chicago as high as 7.825c. and the seller intimated that the St. Louis price should be 7¾c. The volume of sales has been of about the usual proportions, and it continues to be a sellers' market. Some contraction has recently been noted in the requirements of white-lead and battery manufacturers, and some automobile companies are taking a little less than they did. On the other hand, the cable business continues at record proportions and the mixed metal and ammunition manufacturers have taken large amounts.

No differential is being quoted between the prices of prompt and forward lead, though some sellers have little to offer for early shipment.

Zinc Dull and Weak

A modest business in zinc has been done during the week ending today, most of it at 6.90c., though 6.95c. was obtained last Thursday. Today 6.85c. seems to be the top of the market, with little business in sight. High Grade is quoted at 8.50c. per pound, delivered.

Tin Is Quiet

The tin market has been quiet most of the week, though some tin platers were in the market. Practically no spot Straits tin is obtainable, and premiums of about 1c. above May tin are asked for such as is on the market. Forward tin has been considerably cheaper, ruling at 60@61c. during the week.

Silver Higher and Firm

April 22d brought new low quotations for silver both in New York and London, but on April 23d the Indian bazaars came in as substantial buyers, and the market showed real strength for the first time in many weeks. This demand continued on April 24th and 26th, India buying both in London and New York direct, and London buying in New York for India account. As a result of this inquiry the London market advanced $\frac{5}{16}$d. in three days, and the rally in New York amounted to 1¼c. A reaction followed on April 27th, and the market appears steady on the decline, but it is difficult to determine whether the better tone is due to short covering only or to a fundamental improvement in the situation.

Mexican Dollars; April 22d, 48⅜c.; 23d, 48¾c.; 24th, 49¼c.; 26th, 49¼c.; 27th, 48⅞c.; 28th, 49c.

Canadian Exchange Up

The premium on Canadian dollars again reached the gold shipment point yesterday. Other important foreign exchanges have not fluctuated greatly. Closing cable quotations on Tuesday, April 27, were as follows: francs, 3.34c.; lire, 4.02⅝c.; marks, 23.80⅞c. Canadian dollars, $\frac{5}{16}$ per cent premium.

Other Metals

Quotations cover large wholesale lots unless otherwise specified

Aluminum—99 per cent grade, 28c. per lb.; 98 per cent, 27c. London, 98 per cent, £118 per long ton.

Antimony—Per pound, duty paid. New York: Chinese brands, spot, 17.50@16.50c. June arrival, 15.75@16c. Cookson's "C" grade, spot, 22c. Market very dull and prices purely nominal.

Bismuth—$2.70@$2.75 per lb., in ton lots. London, 10s.

Cadmium—60c. per lb. Market better. London, 1s. 9d. for Australian metal.

Iridium — $200@$215 per oz. for 98@99 per cent. Nominal. London, £70@£75 for 99.5 per cent.

Nickel—Ingot, 35c.; shot, 36c.; electrolytic, 39c. (99.75 per cent); London, £170@£175 per long ton.

Osmium—$85@$90 per ounce; London, £19@£22.

Platinum—Per ounce refined, officially quoted: $112 on April 21 and 22; $110 on April 23 and since. Sales also at $105@$107. Crude, $103.50. London, £22½@£23½ for refined; crude, £21@£22.

Quicksilver—Per 75-lb. flask: market firmer at $91@$91.50. San Francisco, $90. London, £15@£15½.

Ruthenium — $75@$85 per ounce; London, £13@£16.

The prices of Cobalt, Germanium Oxide, Lithium, Magnesium, Molybdenum, Monel Metal, Palladium, Radium, Rhodium, Selenium, Tellurium, Thallium, Tungsten, and **Zirconium** are unchanged from the issue of April 3.

Metallic Ores

Tungsten Ore—Per unit of WO_3, N.Y.: Wolframite, $11@$11.50; Western scheelite, $12@$13. Domestic demand very light, and prices largely nominal.

Vanadium Ore—Containing 4 to 8 per cent V_2O_5, 30@35c. per pound of V_2O_5 f.o.b. Montrose, Colo.

Foreign concentrate (lead vanadate) 12 to 18 per cent V_2O_5, 60@65c. per pound V_2O_5, duty paid, seaboard.

Chrome Ore, Manganese Ore, Molybdenum, Tantalum, and **Iron Ores** are unchanged from quotations in the April 3 issue.

Lead Ore Unchanged—Zinc Blende Lower

Joplin, Mo., April 24, 1926

Zinc Blende	Ton
High	$52.70
Premium blende, basis 60 per cent zinc	$47.00@48.00
Prime Western, basis 60 per cent zinc	46.00
Fines and slimes, 60 per cent zinc	45.00@43.00
Average settling price, all zinc	45.70
Galena	
High	$102.80
Basis 80 per cent lead	95.00
Average settling price, all lead	99.74

Shipments for the week: Blende, 16,381; lead, 2,517 tons. Value, all ores the week, $999,680.

Shipments for four months: Blende, 286,906; lead, 41,010 tons. Value, all ores four months, $19,437,640.

Production was less than 16,000 tons this week, a drop of 3,500 tons from the peak production of more than 19,000 tons per week during February. With a reserve stock of 28,800 tons, several of the companies producing a large tonnage closed their mills last Saturday and others followed tonight. Zinc prices are at par with or less than cost of production and these companies can no longer produce and market zinc at a profit. Lead stocks exceed 13,000 tons, and it was reported early in the week that prices would be lower. However, tonight the market has evened up on the same basis as last week.

Purchases this week dropped to 10,180 tons, 450 tons of which was for export.

Platteville, Wis., April 24, 1926

Zinc Blende	Per Ton
Blende, basis 60 per cent zinc	$49.50
Lead Ore	
Lead, basis 80 per cent lead	$97.50

Shipments for the week: Blende, 1,324 tons; lead, 30 tons. Shipments for the year: Blende, 16,527; lead, 432 tons. Shipments for the week to separating plants, 1,841 tons blende.

Non-Metallic Minerals

Amblygonite, Andalusite, Asbestos, Barytes, Bauxite, Borax, Celestite, Chalk, China Clay, Diatomite, Emery, Feldspar, Fluorspar, Fuller's Earth, Garnet, Gilsonite, Graphite, Greensand, Gypsum, Ilmenite, Iron Oxide, Lepidolite, Limestone, Magnesite, Manjak, Mica, Monazite, Ocher, Phosphate, Potash, Pumice, Pyrites, Quartz Rock Crystal, Rutile, Silica, Spodumene, Sulphur, Talc, Tripoli, and **Zircon** are unchanged from prices in the April 3 issue.

Mineral Products

Arsenious Oxide (White arsenic)—3½c. per lb. Several carloads sold. London, £14@£15 per long ton.

Copper Sulphate, Sodium Nitrate, Sodium Sulphate, and **Zinc Oxide** are unchanged from prices in the April 3 issue.

Ferro-Alloys

Ferromanganese — Domestic, 78@82 per cent, $88@$90 per gross ton furnace; prompt and future.

Ferrocerium, Ferrochrome, Ferrophosphorus, Ferrosilicon, Ferrotitanium, Ferrotungsten, Ferro-uranium and **Ferrovanadium** are unchanged from prices in the April 3 issue.

Metal Products

Rolled Copper — Sheets, 22½c.; wire, base price, 16c. per lb.

Zinc Sheets — 11.75c. per lb., f.o.b. works.

Lead Sheets, Nickel Silver, and **Yellow Metal** are unchanged from prices in the April 3 issue.

Refractories

Chrome Brick, Firebrick, Magnesite Brick, Silica Brick, and **Zirkite** are unchanged from prices in the April 3 issue.

Steel, Pig Iron, and Coke Dull But Firm

Pittsburgh, April 27, 1926

The decrease in the volume of steel buying began late in March, in a mild way, and has been much more pronounced in the last fortnight. New business is now running at 50 to 60 per cent of capacity, and there is little backlog business. In the last six months mill operations have averaged between 85 and 90 per cent of capacity, but in March they were exceptionally high—92 per cent. To date they have at least dropped to the average, and some further decrease is to be expected. The light buying at the moment is attributable partly to the lateness of spring, which has delayed consumption, but a downward swing was to be expected in any event.

Pig Iron—The market is very quiet. Bessemer and basic have dropped their ranges, former minimums becoming the whole market. Bessemer, $19.50; basic, $18.50; foundry, $19, f.o.b. Valley furnaces.

Connellsville Coke — Production is closely adjusted to contract requirements and the light spot demand has not depressed prices farther. Spot furnace, $3@$3.15; spot foundry, $4@$4.50.

Has the German Metal Trade Turned the Corner?

By Dr. James Rubinfeld
Special Correspondent, Berlin, Germany

SINCE I last wrote you, the German metal trade has been featureless, no outstanding event having been worth special notice. Looking over the last months, however, one cannot but state that developments have been decidedly downward here; the process of disorganization—nay, of dissolution—caused by the crippling of affairs all-around, has already reached a degree not dreamt of in the days of currency stabilization. Compare the figures of metal imports:

January-February Imports

Metric Tons

	1926	1925		1926	1925
Copper	16,332	39,140	Aluminum	732	1,542
Lead	12,738	23,224	Nickel	99	329
Zinc	8,437	19,743	Antimony	206	456
Tin	1,240	2,474	Silver	37	173

Option business on the metal bourses of Berlin and Hamburg has fallen off more and more, and the number of traders (which was so great at the end of the inflation period) has decreased by a third. The news of a universal association of copper producers being re-established has thus far had the effect to create a cautious attitude among users, who are sure of some price stabilization of the red metal, the more so as a great many American concerns have taken participation in the affairs of German metal firms in the guise of representatives and so on. A distinct movement now exists among both weak and strong metal firms to join together to meet "foreign" competition and to put themselves on a sounder basis by amalgamation of affairs. It is a recurrent argument that the Metallgesellschaft of Frankfort-on-the-Main and the Aron Hirsch concerns are greatly benefiting from joint action when purchasing crude metal and in certain other lines.

The financial stringency of the Federal Railways, which are trying to meet their obligations under the Dawes Plan, has resulted in deferring much buying that would otherwise have enlivened the metal business considerably. At last, however, comes the news that the railways, as well as the Federal Postal Ministry, will again come into the market soon, the former by the help of a banking credit backed by the State, the latter by a loan which is supposed to be destined for the enlarging of the telegraph lines in the country. Also, the electrification of the Berlin city railway will become a fact shortly. Thus the hope is justified that the unemployment which up to very recently formed a formidable threat to economic life will decrease, and the money situation will ease off. Money rates are already nearing foreign ones.

As in every economic system which is in the state of readjustment, there are a lot of paradoxes. For instance, the Mansfeld Company of Eisleben, which in the last working year suffered a loss of 2,700,000 reichsmarks, and the ability of which to produce copper on a paying basis was considered doubtful even by experts, can pay a dividend now of 8 per cent owing to the success of its rolling and trading departments. This company is said to be considering the production of electrolytic copper and plans are under way to enlarge matte production at Gottessegen. Negotiations with American and British banks for a credit to the Mansfeldscher Metallhandel in Berlin to the extent of 9,000,000 marks are believed to be nearly completed. This leaves some questions open as to the intentions on both sides. Is the Mansfeld Company to act in future as a competitor of America in the copper field or on the lines of the Association?

Also, in another matter which touches American interests, the Giesche-Harriman affair, which for a long time had stirred the public attention in Europe, is still somewhat beclouded because on the German as well as on the Polish side of the frontiers much opposition of Parliaments and of certain parties involved is still alive beneath the ashes. It seems certain that the Harriman interests will attain the desired tax exemptions in Poland, but the bone of contention will be the zinc ore on the German side, which the Prussian Finance Ministry insists upon being smelted in a German smelter to be erected in Silesia. And this point of issue entails credit and finance questions which are far from being entirely cleared. This is to the detriment of the German zinc industry, since with the exception of "fine" zinc smelters there is practically no independent zinc smelting in this country. Even the Schleische Bergwerks-und-Hütten Aktiengesellschaft of Beuthen with its newly built aërial ropeway from the mine of Fiedlersglück to the ore-washer of Victoria has to smelt the ore beyond the frontier before receiving it back for manufacture in the four German rolling mills. While the London traders lament the alleged dumping of zinc from Germany and the depreciation of prices thereby, other producers here are satisfactorily occupied as a result of declining raw zinc imports and readjustment measures. The same holds good as regards lead, and it is expected in authoritative circles that a revival of the lead and zinc trades will materialize in the forthcoming building season, to which again relatively big State credits may well contribute.

Germany continues to increase her export volume of aluminum. It turned out in January-February, 1926, as much as 3,531 metric tons, against 64 tons in the same period of 1925. The United States took not less than six-sevenths of the above amount, despite high custom duties ruling across the Atlantic.

Nickel coins are again to be struck according to the proposals of the treasury. The outstanding aluminum bronze coint of fifty renten-pfennige will be withdrawn and replaced by nickel coins to the amount of 90 million marks. Besides, another minting of 200 million silver coins of 1 and 2 marks is under way. The white metal will be taken, however, from accumulated reserves.

April Mining Dividends Show Little Change

The following dividends were paid in April, 1926, by mining and metallurgical companies operating in the Americas:

Companies in the United States	Situation	Per Share	Total
Aluminum Co. of America, pfd	Various	$1.50 Q	$2,208,625
Cresson Consolidated Gold	Colo.	0.10 Q	122,000
Eagle-Picher Lead, pfd., l, z	Okla., Mo.	1.50 Q	12,829
Gladstone Mountain, l	Wash.	0.005M	6,609
Homestake Mining, g	S. D.	0.50 M	125,580
Inland Steel, pfd	Minn.	1.75 Q	175,000
Inspiration Consolidated Copper	Ariz.	0.50 Q	590,983
Kennecott Copper	Alaska	1.00 Q	4,474,281
Magma Copper, c, s	Ariz.	0.75 Q	306,116
Mammoth Mining, l, s, c, g	Utah	0.10 K	40,000
Newmont Mining, h	Various	0.60 Q	258,000
Nichols Copper, pfd	N. Y.	1.75 Q	40,434
Park-Utah Consolidated, s, l, z	Utah	0.15 Q	314,025
Phelps Dodge, c	U. S. and Mex.	1.00 Q	500,000
Portland Gold	Colo.	0.02	60,000
Ray Consolidated Copper	Ariz., N. M.	0.25	715,048
Republic Iron & Steel, pfd	Various	1.75 Q	437,500
Silver King Coalition, s, l	Utah	0.25 Q	304,025
Sloss-Sheffield Steel & Iron, pfd	Ala.	1.75 Q	117,250
Tonopah Mining, s, g	Nev.	0.075SA	75,000
U. S. Smelting, Ref. & Mng., s, l	Various	0.875Q	307,225
U. S. Smelting, Ref. & Mng., pfd	Various	0.875Q	425,556
Utah-Apex, l, c, s, g	Utah	0.35 Q	184,870
Companies in other countries			
Ahumada Lead, l, s	Chihuahua	0.25 Q	298,004
Dome, g	Ont.	0.50 Q	500,000
Erupcion, l, s	Chihuahua	0.10 Q	125,000
Hollinger Consolidated Gold	Ont.	0.08 4 wks.	393,600
Howe Sound, c, l, s	B. C., Mex.	0.75 Q	297,622
Kerr Lake, s, g	Ont.	0.125SA	75,000
Lucky Tiger-Combination, g, s	Sonora	0.12 M	85,840
N. Y. & Honduras Rosario, g, s	Honduras	0.50 Q	100,000
Nipissing, s	Ont.	0.15 Q	180,000
Premier Gold, s, g	B. C.	0.08 Q	400,000
Silversmith, s, l, z	B. C.	0.02 Q	50,000
Whitewater, l, z	B. C.	0.01 I	10,000
Wright-Hargreaves, g	Ont.	0.075 Q	206,250
Total			$14,522,272

Q, quarterly; M, monthly; K, irregularly; SA, semi-annually; I, initial; l, lead; z, zinc; g, gold; c, copper; s, silver; h, holding company.

The total of dividends paid in April was approximately the same as for the preceding quarter. Over $2,000,000 was paid by the Aluminum Co., some of whose stock is now in the hands of the public, and whose distributions have not been listed in this column before. This is offset by about the same amount that was paid by the Consolidated M. & S. Co. of Canada in January but not in April, that being a semi-annual dividend. Portland Gold paid its first dividend since Oct. 20, 1920; Ray Con. made its first distribution since Dec. 31, 1920; and Whitewater Mines, Ltd., a small British Columbia producer, enters the list for the first time. Howe Sound increased its dividend from 50 to 75c., and Lucky Tiger-Combination paid 12c. instead of 7c., last month's distribution. No dividend from Tonopah Belmont Development is reported, so that company probably passed its regular semi-annual payment of 5c. per share. Wright-Hargreaves

paid 7½c. per share, compared with 10c. in January and 5c. in October.

The dividend yields on the stocks of the above companies that are on a regular dividend basis, based on the regular April distributions and on recent market prices, are as follows:

Company	Per Cent Annual Yield	Company	Per Cent Annual Yield
Erupcion	24.6	Inspiration	8.8
Kerr Lake	22.2	U. S. Smelting	8.8
Gladstone	20.3	Magma Copper	8.3
Cresson	17.8	Kennecott	7.7
Utah-Apex	17.0	Rep. I. & S., pfd.	7.4
Silversmith	16.8	U. S. Smg., pfd.	7.2
Premier Gold	14.8	Sloss-Shef., pfd.	6.7
N. Y. & Hond	14.3	Inland Steel, pfd.	6.4
Dome	14.2	Aluminum, pfd.	6.0
Silver King	13.7	Hollinger	5.8
Nipissing	11.7	Eagle-Picher, pfd.	5.5
Ahumada	11.4	Newmont	4.7
Homestake	11.0	Wright-Hargreaves	3.8
Park Utah	9.4	Phelps Dodge	3.3
Howe Sound	9.3	Tonopah	2.6
Average			10.7

Opportunities in British Copper Shares

The speculator who wishes to indulge his fancy in copper shares must turn to the new African fields, says *The Statist*, a London financial paper. The Tanganyika and Rhodesian areas are undoubtedly destined to become ultimately challengers of the United States' supremacy among copper producers of the world. The Union Minière output for 1925 was slightly lower than the 1924 production, but this is not to be taken as evidence of an incipient decline. The company's ore reserves have as yet scarcely been touched; they have been calculated at nearly five million tons of copper. Any increase in the dividends paid by this company will be reflected in an appreciation of the shares of Tanganyika Concessions, which is largely interested in the Belgian company.

Two Rhodesian companies whose shares should appeal as speculative lock-ups are the Bwana M'Kubwa and the Kafue Copper. The former has proved the existence of a very large body of low-grade ore on its properties. . . . The Kafue company owns properties in Northern Rhodesia on which no prospecting work has been done since the break in copper prices in 1920. Prospecting work has been carried on over areas adjoining the company's properties, and would seem to indicate the existence of valuable bodies of ore. The Kafue company is also interested in gold alluvial areas in Canada, and operations in this sphere have been so successful as to warrant the expectation of a small dividend in the near future. The 2s. 6d. shares quoted at 2s. 9½d. appear attractive as a mining speculation. Details of copper-producing companies' shares are given in the following table:

	Par	1925 H.	1925 L.	Dividend Last Financial Year Per Cent	Current Price	Yield, Per Cent
Arizona	5s.	20/3	11/3	15	11/3	6.7
Bwana M'Kubwa	5s.	8/1½	5s.	...	6/7½	....
Hampden	£1	8/4	3/–	...	9/9	....
Kafue Copper	2s. 6d.	4/–	2/–	...	2/11½	....
Mason and Barry	£1	56/10½	33/9	15	30/–	10.0
Messina	5/–	9/4½	6/6	20	9/6	10.5
Mount Lyell	£1	26/3	19/6	11¼	25/–	9.0
Mount Morgan	£1	11/7	5/1	...	8/–	....
Namaqua	£2	43/6	26/10½	...	25/–	....
Rio Tinto—						
Pref.	£5	89/4½	82/6	5	86/3	5.8
Ord.	£5	44 5/16	36½	50	40½	6.2
S. Amer. Copper	2/–	13/1	4/6	...	5/1½	....
Tangan. Concess.—						
Pref.	£1	46/10	25/7	10	40/–	5.0
Ord.	£1	49/9	21/3	...	37/6	....

Fixing the Prices of Raw Materials

It was lately reported that a copper export association would be set up under the provisions of the Export Trade Act of 1918 (commonly known as the Webb-Pomerene Act), says the New York correspondent of the London *Statist*, under date of March 26. His views will interest many United States readers. It seems, he says, that one of the principal objects of the promoters of the scheme is to prevent price cutting among the producers in this country, particularly in their dealings with British and other European buyers. Price-fixing agreements are unlawful in this country, but robustly abound here; in fact, our Secretary of Commerce has fairly completed the task of having the ban against them removed once for all. But, since 1918, exporters of commodities are quite in a position to secure immunity from prosecution for price fixing so long as the agreement complies with the provisions of this act and operates only abroad. It will, no doubt, make industrial concerns in Great Britain and elsewhere quite enthusiastic about our current crusade against monopolies and governmental valorization the world over, to learn that our government is about to sanction a price-fixing program on a gigantic scale for an essential raw material of which the United States is the principal producer.

Company Reports

Bingham Mines Co.

According to the report of the Bingham Mines Co., operating in the Bingham and Tintic districts, in Utah, earnings for 1925 from mining operations were $439,327.26, after deducting $110,768.34 for prospecting and development work at the Dalton & Lark and Victoria mines. Total dividends received from the Eagle & Blue Bell Mining Co. were $173,508.40, and interest received totaled $10,220.17, making the total income for the year $623,055.83, an increase of $361,548.76 over the previous year.

Tonnages and smelter returns of the ore shipped during the year are as follows:

Mine	Dry Tons	Smelter Returns
Victoria (*a*)	22,282	$669,548.93
Dalton & Lark (*a*)	30,344	351,361.23
Eagle & Blue Bell (*a*)	25,873	266,141.63
American Star	2,849	14,092.82
Commercial (*b*)	301	8,592.99
Total	81,651	$1,309,737.60

(*a*) Includes lease ore. (*b*) Lease ore only.

Consolidated Income Statement—1925

Gross Income from Operations		
Ore shipments	$1,584,012.95	
Royalties	81,772.99	
Rents	5,249.06	
Commissions	2,220.64	
Miscellaneous	5,086.34	$1,678,341.98
Operating Expenses		
Smelting, freight, sampling and assaying	$528,051.67	
Mine operations	302,476.10	
Management and miscellaneous	58,446.72	
Insurance	130,364.94	1,019,339.43
Net earnings and revenues		$659,002.55
Prospecting and development of mines		146,273.68
Net operating gain		$512,728.87

American Zinc, Lead & Smelting Co.

The report of the American Zinc, Lead & Smelting Co. and its subsidiary companies for the year ended Dec. 31, 1925, shows:

Profits from operations being the results of the sales of zinc and lead ores, sales of spelter, pig lead, zinc oxide limestone and sulphuric acid, receipts from royalties; after deducting all cost of mining, manufacture, marketing, administration, selling and taxes	$549,690.77
Deduct interest on bonds, less interest on bank deposits	50,864.69
Total profit	$498,826.08
Earned surplus at Dec. 31, 1925	1,926,655.46
	$2,425,481.54
Deduct depletion and depreciation reserves	511,066.91
Earned surplus at Dec. 31, 1925	$1,914,414.63

At the Douthat property, in Oklahoma, upon which the company erected a mill which was put in operation at the beginning of 1925, operations were conducted on a profitable basis throughout the year. The investment in this property and the cost of the concentrating facilities were amortized out of its earnings before the end of the year.

The volume of limestone business in Tennessee, a by-product of mining operations, was increased and yielded a fair margin of proft. Operations of the Silver Dyke Mining Co., in which the company owns approximately 69 per cent of the outstanding stock, were on the whole unsatisfactory. During the first half of the year, owing to a shortage of water and other physical difficulties, mining operations resulted in a deficit of $34,929.65. An earthquake in Montana caused the tailings dam to break in July, which disorganized

operations for some time. Thereafter a substantial improvement in metallurgical results and earnings occurred, which continued until heavy snows in October interfered with the open-pit operations. The mining profit for the last half of the year amounted to $78,967.30. In the course of developing certain areas for mining operations additional ores were discovered equal in amount to about 60 per cent of the ore extracted during year 1925. The zinc ore reserves at Mascot, Tenn., were greater at the end of the year than they were at the beginning.

Old Dominion Income $501,963

The total production of the Old Dominion company, from its mines at Globe, Ariz., for the year 1925, including custom ores, was as follows: 27,283,655 lb. refined copper; 150,782 oz. silver; and 5,752 oz. gold. Copper was sold to buyers at an average price of 14.0856c. per pound.

The tonnage of all ore mined during the year, 355,633, was the highest during any year in the history of the mine, except for the record for the year 1916, when 358,223 tons of ore was mined. The grade of both the smelting and concentrating ores was higher than that of last year, but the decrease in the amount of smelting ore mined resulted in the average grade of all ore mined dropping to 4.16 per cent, compared with 4.62 per cent in the previous year.

Income Account, Year Ending Dec. 31, 1925

Income		
Sales of copper, silver and gold	$3,809,272.05	
Income from investments and miscellaneous earnings	17,073.70	
		$3,826,345.75
Expenses		
Mining, treating and refining	$3,209,275.11	
Selling expense	33,915.65	
Depreciation	76,856.72	
Interest	4,335.01	
		3,324,382.49
Income, before depletion, for the year 1925—carried to balance sheet		$501,963.26

Current assets as shown on the balance sheet were $1,920,425 against current liabilities of $477,228.

Phelps Dodge Income $5,058,006 After Charging Depreciation

Operations by the Phelps Dodge Corporation in Arizona, New Mexico, and Sonora, Mex., during 1925, yielded $5,058,006 after charging $2,467,045 to depletion. Income from the sale of metals, fuel, and merchandise totaled $39,357,009; miscellaneous income was $350,075; operating expense $31,753,603; and interest paid $428,429. Current assets as of Dec. 31 were $25,758,980, against current liabilities of $7,536,399.

The metals produced from the ores of the branches and subsidiaries of the corporation for the year 1925 were 207,175,518 lb. of copper, 7,463,906 lb. of lead, 1,780,690 oz. of silver and 41,165 oz. of gold. There were also produced from purchased ores smelted 1,936,058 lb. of copper, 156,840 oz. of silver and 3,486 oz. of gold. Including copper received from other sources, 287,884,234 lb. was sold at an average net price f.o.b. refinery of 14.044c. per pound.

Kennecott Operating Revenue $29,971,585

The first consolidated report covering Utah Copper as well as Braden and Alaskan operations shows net operating revenue of $29,971,585 for the Kennecott Copper Corporation in 1925.

The consolidated net earnings amounted to $6.21 per share, before deductions for depreciation and depletion. After making a proper allowance for depreciation at all the properties, earnings per share were $5.34.

Production amounted to 411,088,627 lb. of copper. This does not include the company's equity in the production of the Nevada Consolidated and Mother Lode properties. Average cost of producing copper during the year, after charging in depreciation and taxes and crediting silver and miscellaneous earnings, but before depletion, was 8.07c. per pound. The average selling price during the year was on the basis of 14.286c. per pound of electrolytic copper.

Braden Operations

Ore mined amounted to 4,277,000 tons. Smelter production was 154,117,828 lb. of copper. Mill results were as follows:

Total tons milled	4,283,065
Average tons milled per operating day	11,734
Heads copper, per cent	2.349
Final tails, copper, per cent	0.487
Recovery, per cent	80.83
Tons concentrates produced	318,306

The average smelter recovery of copper was 97.28 per cent. Ore reserves as at Dec. 31, 1925, were approximately 253,000,000 tons of a grade averaging 2.20 per cent copper.

Alaskan Operations

The following ore was produced with copper and silver contents as shown:

	Tons	Copper, per Cent	Silver, Oz. per Ton	Copper, Tons	Silver, Oz.
Kennecott	136,836	10.72	2.20	14,672	301,274
Latouche	493,005	1.663	0.29	8,200	142,971
	629,841	3.63	0.705	22,872	444,245

Shipments to smelter totaled 64,351 tons, containing 42,808,660 lb. of copper and 369,183 oz. of silver. The average metallurgical efficiency of the two plants combined was 93.73 per cent.

[The operating results of the Utah Copper Co. were shown in the *Engineering and Mining Journal-Press* of April 24.]

Consolidated Balance Sheet Kennecott Copper Corporation and Subsidiaries Dec. 31, 1925

Assets

Current Assets		
Cash	$14,298,979.11	
Marketable securities	7,281,270.95	
Accounts receivable	3,907,945.14	
Metals on hand and in transit	17,753,110.46	
Ore and concentrates on hand	560,538.92	
Materials and supplies	7,092,976.72	
		$50,894,821.30
Investments in securities of partly owned allied and affiliated corporations		6,582,413.25
Insurance reserve-fund investments		548,459.40
Bond deposit account		800,000.00
Deferred charges to future operations:		
Stripping and mine development	$15,965,130.10	
Prepaid insurance and taxes	231,871.60	
Miscellaneous deferred accounts	2,330,379.81	
		18,527,381.51
Mining properties, railroads, steamships, plants and equipment—net, after deducting depreciation		190,699,115.58
		$268,052,191.04

Liabilities

Current liabilities		
Accounts payable	$4,183,147.91	
Treatment, refining and delivery charges not yet due	1,946,562.03	
		$6,129,709.94
Reserves		
For taxes	$3,470,869.16	
Insurance and other contingencies	1,424,616.10	
		4,895,485.26
Notes outstanding		4,000,000.00
Capital—Kennecott Copper Corporation—4,474,424-23/208 shares of no par value outstanding		
Stated capital	$25,000,000.00	
Capital surplus	145,026,031.00	
		170,026,031.00
Minority interests in capital stock and surplus of subsidiaries at book values		3,644,054.98
Earned surplus (without deduction of any depletion based on March 1, 1913 values) applicable to Kennecott stock		79,356,909.86
		$268,052,191.04

Consolidated Statement of Income, Year Ended Dec. 31, 1925

Operating revenue		
Copper		$58,988,798.65
Gold and silver		2,327,862.15
Railroad, steamship and wharf		6,546,453.59
Total operating revenue		$67,863,114.39
Operating costs		
Cost of metal production, including mining, treatment and delivery	$33,087,535.17	
Railroad, steamship and wharf operating costs	4,803,993.45	
Total operating costs		37,891,528.62
Net operating revenue		$29,971,585.77
Other receipts		
Dividends, interest and miscellaneous		2,315,024.37
Total income		$32,286,610.14
Deduct		
Interest on short-term notes	$495,555.56	
Taxes	3,369,159.71	
Depreciation	3,991,607.13	
		7,856,322.40
Net income for year		$24,430,287.74
Less minority interest in income of subsidiaries		540,243.35
Net income applicable to Kennecott stock (after depreciation)		$23,890,004.39

Mining Stocks—Week Ended April 24, 1926

Stock	Exch.	High	Low	Last	Last	Div.
COPPER						
Anaconda	New York	44	42¼	44	Ap.17, My.24	0.75
Arcadian Consol.	Boston	*90	*75	*88		
Ariz. Com'l.	Boston	9⅞	9½	9⅞	Jy.21, Jy. 31 SA	0.50
Calaveras	N. Y. Curb	2	1½	1½		
Calumet & Arizona	New York	58⅞	57½	58⅞	Mr.5, Mr.21 QX	1.50
Calumet & Hecla	Boston	14⅞	14¼	14⅞	Nov.30, De.15 Q	0.50
Cerro de Pasco	New York	64	61	63⅞	Ap. 15, My. 1, Q	1.00
Chile Copper	New York	33	31⅞	32¾	Ma.3, Ma.29, Q	0.62½
Chino	New York	21¼	20½	20⅞	Sept., 1920	0.37½
Con. Coppermines	N. Y. Curb	2⅜	1½	2⅞		
Copper Range	Boston	15⅝	15	15½	May, 1925	1.00
Crystal Copper	Boston Curb	*39	*34	*35		
East Butte	Boston	3⅜	3	3½	Dec., 1919	0.50
First National	Boston Curb	*17	*16	*17	Feb., 1919	0.15
Franklin	Boston	*75	*59	*75		
Granby Consol.	New York	19½	17⅞	18½	May, 1919	1.25
Greene-Cananea	New York	10⅛	10	10⅛	Nov., 1920	0.50
Hancock	Boston	1	*50	1		
Howe Sound	New York	32½	31¼	32½	Ap.1, Ap.15	0.75
Inspiration Consl.	New York	23⅝	22	23¼	Mar.18, Ap.5, Q	0.50
Iron Cap	Boston Curb	4	3½	3¾	May, 1923	0.15
Isle Royale	Boston	11	10⅛	10⅛	No.30, De.5	1.00
Jerome Verde Dev.	N. Y. Curb			*95		
Kennecott	New York	53	51⅝	53	Ma.5, Ap.15 Q	1.00
Lake Copper	Boston			1½	June, 1925	0.50
Magma Copper	New York	36½	34	36⅝	Mh.31, Ap.15, Q	0.75
Mason Valley	N. Y. Curb	2½	2	2		
Mass Consolidated	Boston	*40	*25	*40	Nov., 1917	1.00
Miami Copper	New York	12½	11⅞	12½	My.1, My.15 Q	0.25
Mohawk	Boston	33	31½	33	My.1, Je.1 Q	1.00
Mother Lode Coa.	New York	6½	6½	6⅝	De. 11, De. 31	0.37½
Nevada Consol.	New York	13	12⅝	12⅝	Mh.18, Mh.31 Q	0.25
New Cornelia	Boston	20⅜	20¼	20½	My.7, M.24 Q	0.40
North Butte	Boston	2¼	2¼	2¼	Oct., 1918	0.25
Ohio Copper	N. Y. Curb	*50	*50	*50	No. 14, De. 2	0.05
Old Dominion	Boston	16	15½	15⅝	Dec., 1918	1.00
Phelps Dodge	Open Mar.	†125	†120		Mar.20, Apr.20	Q 1.00
Quincy	Boston	19½	18⅜	19⅛	Mar., 1920	1.00
Ray Consolidated	New York	12⅜	12½	12⅛	Ap.20, Ap.30	0.25
Ray Hercules	N. Y. Curb			11⅜		
St. Mary's Min. Ld.	Boston	29½	28	29	Ap.17, My.18	2.00
Seneca Copper	New York	6	5½	5⅝		
Shannon	Boston	*50	*45	*45	Nov., 1917	0.25
Superior & Boston	Boston	*50	*35	*35		
Tenn. C. & C.	New York	12	11¼	12	Fe.27, Ma.15, Q	0.25
United Verde Ex.	N. Y. Curb	28½	28	28⅛	Ap.6, My.1	0.75
Utah Copper	New York	99½	99⅛	99¼	Mh.18, Mh.31, Q	1.25
Utah Metal & T.	Boston	1⅛	1⅛	1⅛	Dec., 1917	0.30
Victoria	Boston			*60		
Walker Mining	Salt Lake	*90	*65	*90		
NICKEL-COPPER						
Internat. Nickel	New York	37¼	34½	36½	My.11, My.31, Q	0.50
Internat. Nickel, pfd.	New York	104¼	102	102	Ap.15, My.1, Q	1.50
LEAD						
Gladstone M. M. Co.	Spokane	*32½	*29½	*32	Ja. 1, Ja. 10 M	0.0½
National Lead	New York	150	138	149	Ma.12, Ma.31 Q	2.00
National Lead pfd.	New York	118	118	118	My.21, Je.15 Q	1.75
St. Joseph Lead	New York	39¾	38	39¼	Je.10, Je. 21 QX	0.75
ZINC						
Am. Z. L. & S.	New York	8	7⅜	8	May., 1920	1.00
Am. Z. L. & S, pfd.	New York	30	28½	30	Nov., 1920	1.50
Butte C. & Z.	New York	5	4⅞	5	De.10, De.24	0.50
Butte & Superior	New York	12⅜	12¼	12¼	Ma.15, Ma.31 Q	0.50
Callahan Zn-Ld	New York	1⅜	1½	1⅜	Dec., 1920	0.50
Eagle Picher	Cincinnati	28⅜	28	28	My. 15, Jn.1	0.40
Eagle Picher, pfd.	Cincinnati	...	...	110	Mh.31, Ap.15 Q	1.50
New Jersey Zn.	N. Y. Curb	...	...	208	Ap.20, My.10 Q	2.00
United Zinc	N. Y. Curb	...	...	*70		
Yellow Pine	Los Angeles	...	...	*22½	De.8, De.18 Q	0.04
GOLD						
Alaska Juneau	New York	1⅝	1½	1½		
Argonaut	Toronto	*30	*27	*27		
Barry-Hollinger	Toronto	*39	*35	*36½		
Carson Hill	Boston			*30		
Consol. W. Dome L.	Toronto	*19	*18	*19		
Cresson Consol. G.	N. Y. Curb	2¼	2¼	2¼	Mh.31, Ap 10	0.10
Crown Reserve	Toronto	*15	*13½	*13½	Jan., 1917	0.05
Dome Mines	New York	14¼	14	14¼	Mh.31, Ap.20, Q	0.50
Golden Center	N. Y. Curb	2⅛	1⅞	2		
Golden Cycle	Colo. Springs	1.51	1.50	1.51	No.30, Dec.10 Q	0.03
Hollinger Consol.	Toronto	18.10	18.00	18.00	Ap. 6, Ap.22,	0.08
Homestake Mining	New York	55	55	55	Ap.20, Ap.26 M	0.50
Kirkland Lake	Toronto	1.26	1.15	1.19		
Lake Shore	Toronto	10.35	9.99	10.35	Ma.1, Ma.15 Q	0.10
McIntyre-Porcupine	New York	25⅛	25	25¼	My.1, Je.1	0.25
Newray	Toronto	*35½	*35	*35		
Night Hawk Pen	Toronto	*6	*5½	*6		
Noranda	N. Y. Curb	16⅜	15¼	16½		
Portland	Colo. Springs	*54	*54	*54	Apr.6, Apr.15	0.02
Rand Mines	New York			34⅜	Fe.16, Fe.26	1.52
Teck-Hughes	Toronto	3.45	3.22	3.42	Ja. 15, Fe. 1	0.05
Tom Reed	Los Angeles			*72½	Ma.10 Ma.20	0.02
Tough-Oakes	Toronto	*45	*38	*41		
United Eastern	N. Y. Curb	*39	*38	*39	July, 1924	0.05
Vipond Cons.	Toronto	1.64	1.59	1.61		
Wright-Hargreaves	Toronto	8.00	7.75	8.00	Mh.15, Ap.1	IQX 0.07½
Yukon-Alaska Trust	N. Y. Curb	...	...	21½		
GOLD AND SILVER						
Carnegie Metals	Pittsburgh	17½	17	17½		
Con. Cortez	N. Y. Curb	...	...	*6		
Con. Virginia	San Francisco	...	...	*11½		
Continental Mines	N. Y. Curb	...	...	*45		
Dolores Esperanza	N. Y. Curb	*50	*50	*51	July, 1923	0.05
Premier Gold	N. Y. Curb	2¼	2⅛	2¼	Mh.19, Apr.3	Q 0.08
Tonopah Belmont	N. Y. Curb	3	2⅞	2⅞	Se.15, Oc.1	0.05
Tonopah Extension	N. Y. Curb	*55	*53	*55	Apr. 1925	0.05
Tonopah Mining	N. Y. Curb	5¼	5¼	5¼	Ap.7, Ap.21 Q	0.07½
Unity Gold	N. Y. Curb	...	...	*20		
West End Consol.	N. Y. Curb	...	...	*25	Mar., 1923	0.05
Yukon Gold	N. Y. Curb	...	...	*45	June, 1918	0.02

Stock	Exch.	High	Low	Last	Last	Div
SILVER						
Alvarado	N. Y. Curb	....	....	1	Oct., 1920	0.50
Beaver Consol.	Toronto	*81½	*78	*79½	May. 1920	0.03
Castle-Trethewey	Toronto	1.53	1.50	1.50		
Coniagas	Toronto	3.75	3.75	3.75	May, 1924	0.12½
Keeley	Toronto	1.66	1.61	1.62	Ma. 1, Ma. 15	X 0.12
Kerr Lake	N. Y. Curb			1	Ap.1, Ap.15	0.12½
La Rose	Toronto	*14	*13	*14	Apr., 1922	0.10½
Lorrain Trout Lake	Toronto			*85	Jy. 2, Jy. 15	0.05
McKinley-Dar.-Sav.	Toronto	*18	*15½	*18	Oct., 1920	0.03
Mining Corp. Can.	Toronto	3.67	3.55	3.62	Ja. 16, Ja.30	0.12½
Nipissing	N. Y. Curb	5⅛	5⅛	5⅜	Mh.31, Ap.20, Q	0.15
Temiskaming	Toronto	....	....	*12½	Jan., 1920	0.40
SILVER-LEAD						
Ahumada	New York	8⅞	8¾	8⅞	Mh.8, Ap.5, Q	X 0.25
Alta Merger	Salt Lake	†*3½	†*2			
Bingham Mines	Boston	37½	36½	36⅞	Ma.20, Ma.31 Q	1.00
Cardiff M. & M.	Salt Lake	*51	*49	*51	De.16, No.18	0.10
Chief Consol.	Salt Lake	3.00	3.00	3.00	Fe. 1,	0.10
Emma Silver	Salt Lake	†1	†*50			
Erupcion	Boston Curb	1⅜	1¼	1⅜	Mh.18, Ap.5, X	0.10
Federal M. & S.	New York	81	70	72		
Federal M. & S., pfd.	New York	78	72	75	No.25, De.15 Q	1.75
Hawthorne Mines	N. Y. Curb	*18	*14	*18		
Hecla Mining	N. Y. Curb	17⅛	16⅞	17	My.15, Je.15 Q	0.50
Iron King Mining	Salt Lake	25	25	25		
Keystone Mining	Salt Lake	*42	*40	*40	Au.12, Au.26	0.07½
Lucky Jim	Spokane	*16	*15½	*15½		
Mammoth Mining	Salt Lake	2.70	2.65	2.65	Mar 24, Apr. 1	0.10
Marsh Mines	Spokane	*4½	*4	*4	Se.15, Oc.1	0.15
Ontario Silver	New York			10		
Park Utah	Salt Lake	6.35	6.00	6.00	Mh.15, Ap.1	0.15
Prince Cons.	Salt Lake	*2½	2¼	*2½		
Silver King Coal	Salt Lake	7.45	7.25	7.25	Mh.20, Ap.1, Q	0.25
Silversmith	Spokane	*48½	*47½	*48½	Apr.1, Apr.10	0.02
Tamarack-Custer	Spokane	*51	*47	*47	Sept., 1924	0.25
Tintic Standard	Salt Lake	11.59	11.12½	11.25	Mh.1, Mh.20, QX	0.40
Utah-Apex	Boston	8¼	7¾	8¼	Apr. 9, Apr. 15	0.25
Western Utah Copper	N. Y. Curb	...		*8		
IRON						
Bethlehem Steel	New York	42½	38½	41¾	July, 1924	1.25
Colorado Fuel & Iron	New York	36½	31½	35¼	May, 1921	0.75
Gt. North'n Iron Ore	New York	23	22⅜	22⅜	De. 4, De. 28,	0.75
Inland Steel	New York	38½	37	38½	Fe.15, Ma.1 Q	0.62½
Mesabi Iron	N. Y. Curb	1¾	1⅜	1⅜		
Replogle Steel	New York	10	9¼	9⅞		
Republic I. & S.	New York	51⅜	47⅞	51⅝	May, 1921	1.50
Republic I. & S. pfd.	New York	94½	92½	94½	Ma.15, Ap.1, Q	1.75
Sloss-Sheffield S. & I.	New York	115	108¼	114½	Ma.10, Ma.20 Q	1.50
Sloss-Shef. S.&I. pfd.	New York	...	...	103¼	Ma.20, Ap.1, Q	1.75
U. S. Steel	New York	122⅞	118½	122⅛	Fe.27, Ma.3d XQ	1.75
U. S. Steel pfd.	New York	128½	126½	128	Fe. 3, Fe. 27, Q	1.75
Virginia I. C. & C.	New York	45⅞	45⅞	45⅞	Jan., 1924	1.50
Virginia I.C.&C.pfd	New York	...	...	73½	De.15, Ja.2,	2.50
ALUMINUM						
Alum. Co. of Amer.	Open Market	65	64	65		
Alum. Co. of Amer.	Pfd.	99⅜	99⅜	99⅜		
VANADIUM						
Vanadium Corp.	New York	37½	35	36⅜	My.1, My.15, Q	0.75
ASBESTOS						
Asbestos Corp.	Montreal	100	96	100	De.31, Ja.15 Q	1.50
Asbestos Corp., pfd.	Montreal	122	121	122	De.31, Ja.15, Q	1.50
SULPHUR						
Freeport Texas	New York	30½	26⅜	29⅜	Nov., 1919	1.00
Texas Gulf	New York	136½	131	134⅝	Ma.1, Ma.15, Q	2.50
DIAMONDS						
De Beers Consol.	New York	27⅜	27⅜	27⅜	Ja.26, Fe.2	0.23
PLATINUM						
So. Am. Gold & P.	N. Y. Curb	4¼	4	4¼		
MINING, SMELTING, REFINING AND GENERAL						
Amer. Metal	New York	50⅛	49⅜	50⅛	Fe.18, Ma. 1, Q	1.00
Amer. Metal pfd.	New York	113½	113¼	113½	Fe. 19, Ma. 1, Q	1.75
Amer. Sm. & Ref.	New York	117½	109⅜	117⅞	Ap.16, My.1, Q	1.75
Amer. Sm.&Ref.pfd.	New York	115	115	115	My.7, Je.1, Q	1.75
Consol. M. & S.	N. Y. Curb	...	...	208	De.31, Ja.15	0.75
Federated Metals	N. Y. Curb	17⅞	17½	17⅞		
Newmont Mining	N. Y. Curb	51⅜	49½	51	Mar.31, Apr.15,	0.60
Southwest Metals	N. Y. Curb			2		
U. S. Sm. R. & M.	New York	40½	36½	40	Ap.8, Ap 15, Q	0.87½
U. S. Sm. R.&M.pfd.	New York	48½	47½	48½	Ap.8, Ap.15, Q	0.87½

* Cents per share. † Bid or asked. Q, Quarterly. SA, Semi-annually. M, Monthly. K, Irregular. I, Initial. X, Includes extra. The first date given is that of the closing of the books; the second that of the payment of the dividend.

Boston quotations courtesy Boston Stock Exchange; Toronto quotations those of the Standard Stock Exchange of Toronto, by courtesy of Arthur E. Moysey & Co.; Spokane, Pohlman Investment Co.; Salt Lake, Stock and Mining Exchange; Henry Sachs, Colorado Springs, Colo.

PRICE WEEK ENDED APRIL 13th, 1926

Name	High	Low	Last	Last Divd. Date	Amount
Aramayo Mines (25 frs.)	82/6	78/1½	80/6	Feb. 1926	5 p.c.†
British Platinum (£1)	7/6	6/6	6/6	Feb. 1925	2½ p.c.
Burma Corpn. (10 rupees)	16/—	14/9	15/—	Feb. 1926	6 annas*
Bwana M'Kubwa (5s)	7/—	6/6	6/9		
Camp Bird (£1)	5/3	4/10½	5/—		
El Oro (£1)	6/7½	6/—	6/4½	Nov. 1924	2½ p.c.*
Esperanza (10s)	1/6	1/3	1/6		
Frontino & Bolivia (£1)	8/6	8/3	8/6	Jan. 1926	1½ p.c.
Mexican Corpn. (£1)	18/9	17/1½	17/9		
Mexico Mines of El Oro (£1)	31/3	27/6	30/—	Dec. 1925	12½ p.c.*
Oroville Dredging (£1)	3/9	3/6	3/9	Dec. 1923	3¾ p.c.
Ouro Preto (£1)	2/6	2/—	2/—	May 1925	2½ p.c.
Rhodesian Congo Border	113/—	102/6	107/6		
St. John del Rey (£1)	9/4½	7/6	9/3	June 1925	6¼ p.c.
San Francisco Mines (10s)	29/—	25/10½	27/3	Jan. 1926	22½ p.c.
Santa Gertrudis (£1)	2/9	18/9	19/3	July 1920	5 p.c.
Selukwe (2s. 6d.)	11/3	1/4½	10/9	April 1917	6⅔ p.c.
S. Amer. Copper (2s.)	5/1½	4/7¹	4/9	Nov. 1917	75 p.c.
Tanganyika (£1)	43/9	38/—	38/1½	Sept. 1925	5 p.c
Tomboy (£1)	3/9	3/1½	3/3	Jan. 1926	5 p.c.
Union Miniere du Haut-Katanga (Brussels)	6.350	6.150	6.200	July 1925	150 frs.‡

* Free of British income tax. † Swiss frs. ‡ Belgian frs.